# THE AMERICAN GAS LIGHT JOURNAL

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME XCIII., No. 24. Whole No. 1,853. | NEW YORK, MONDAY, DECEMBER 12, 1910. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. H. WADELTON, Manager. THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.


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## DEATH OF MR. FREDERICK LINES BRADLEY.

With exceeding regret we are called upon to report the death of Mr. Frederick Lines Bradley, Division Engineer, Consolidated Gas Company, New York City. Deceased, who was a brother of the Company's Chief Engineer, Mr. William H. Bradley, was stricken with pneumonia some days ago, and succumbed to the attack the morning of the 4th inst. He was in his 61st year, having been born in New Haven, Conn., in 1849. The funeral services were held in St. Stephen's Church, Columbus avenue and Broadway, the 7th inst., and interment was subsequently made in New Haven. The story of his useful life will be printed later on.

[Special Editorial Correspondence.]

## SIXTH ANNUAL MEETING, NATIONAL COMMERCIAL GAS ASSOCIATION.

MECHANICS' BUILDING, BOSTON, MASS., Dec. 6, 1910.

Dear JOURNAL: Unless all signs fail we are to have snow, for at 10 A.M. heavy skies and a brisk northeast wind are ours. To show the interest that the meeting has aroused, I may mention that two hours before the call to order was made over 500 had registered, and at the rate at which the registration is being maintained the Boston gathering will easily be a record breaker. The buildings making up the Mechanics' Building take up a square block, and along this stretch the General Gas Light Company has erected handsome posts of white and gold, carrying 48 Humphrey arcs of 5 inverted burners each. The effect of this mammoth scheme of illumination is great. When President Wrightington called the meeting to order one swift glance over the assemblage was sufficient to show that every division of the industry was represented. Little time, however, was left for "glancing," in that with a speedy swing the sessions were underway. In the preliminaries the most important items were in the Report of the Directors, submitted by Mr. W. J. Clark. This had to do with recommendations: That the body be incorporated under the laws of New York, and that the dual office of Treasurer and Secretary be be divided—these in effect were the main points, and both were accepted. The Directors also noted that the membership for the 12 months had increased beyond 1,000. The value of the "Monthly Bulletin," issued for Association account, was reported on at full length, the idea being advanced that, according to the scale over which it was proposed for printing in 1911 (40 pages monthly), the expenditure of $1,500 for an issue of 2,200 copies per month was more than warranted. The idea of the fostering of local sections was warmly advocated, and it was further shown that the total membership of all sorts now exceeds 2,000. The Chairmen of several Special Committees sent in words respecting the standing of their various charges; and in this connection it should be remarked that the Committee on Illumination made an excellent showing over its doings, in the single item of the effective way in which the Building and its approaches were illuminated. It was also recommended that a standard book, regarding the text on which canvassers were to work, should be formulated. The Treasurer's statements showed a most flourishing financial standing. Mr. Young's report on new members elected—1,100—fairly made the ceiling "wave," so stentorian was the way in which the announcement was received. With the routine out of the way, Vice-President McLean assumed the Chair, while President Wrightington read his annual address.[1] It seemed to me that the Chairman gave quite a bit of consideration to the engineering end of the industry; but that, of course, is natural enough. Evidently, he is no believer in immediate union or amalgamation of the Commercial with the Institute; and 'tis quite likely a majority in both bodies will and do agree with him. However, there's time enough ahead for the final threshing out of this thought. The applause which punctuated the reading beyond cavil showed that the reader and his thoughts were being honored with close attention. A few minor details being disposed of, the Association then voted for office bearers for the ensuing year, with the following result:


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*President.*—Mr. C. N. Stannard, Denver, Col.

*First Vice-President.*—Mr. L. S. Bigelow, Buffalo, N. Y.

*Second Vice-President.*—Mr. Glenn R. Chamberlain, Grand Rapids, Mich.

*Third Vice-President.*—Mr. R. C. Frampton, Pittsburgh, Pa.

*Treasurer.*—Mr. P. S. Young, Newark, N. J.

*Secretary.*—Mr. Louis Stotz, N. Y.

*Directors* (2-year term).—Messrs. E. Haase, Geo. H. Thompson, A. P. Ewing, L. F. Blyler, H. D. Frueauff.

1. For the text of the Address see page 1136.

The President-elect was escorted to a seat on the platform, to the accompaniment of a cheer that sounded loud and long. The Denverite having acknowledged in most gracious way the honor put upon him, the next important thing for consideration was the time and place for next meeting. This choosing led to considerable discussion, the tenor of which emphasized the opposition existing to union with the Institute. It was attempted to have the meeting held in Denver the last week in October, but that was virtually negatived in positive way. So it goes that the meeting will be held in Denver, commencing the first Tuesday in December.

The afternoon session was called to order at 2:30 P.M., and the business proceedings consisted of the reading and discussing of these papers—we may not go further in calling attention to them (both papers and discussions are to be "edited" and then "released" for publication in formal way. The numbers were: "Manufacturers' Paper," by Mr. W. T. Barbour, Detroit; "Compensation of Representatives," by Mr. J. D. Shattuck; "Service," by Mr. C. W. Hare, Philadelphia. Without straining the binding orders I may and do remark that the communications, with the debates thereon, were well worth listening to. The session was declared adjourned at 5 P.M., when the march to the "Show" was made. The lighting of the Hall is excellent, the spacing of the exhibition floor is well planned, the grouping is tasteful, and the officering of the entire space is ample—a very desirable fact, when one remembers some of the untoward happenings at the New York exhibition last year. There are perhaps 3 score of exhibitors, and the exhibits are well manned. Of course, this part of the proceedings will be referred to in later numbers; but I here say that the exhibition, although not on the scale of the New York one a year ago, is nevertheless noteworthy in such displays and royally creditable to the care and skill of those who planned and placed it.

The session of Wednesday was opened at 10:30 A.M., and the opening number thereat was the paper by Mr. C. R. Graves, whose topic was "The Hotel Gas Kitchen." This was followed by Mr. A. V. Wainwright's notes on "Industrial Fuel." At this stage it was announced there would be a business session in the afternoon, for the sightseeing trip had to be postponed because of the promised (surely came) snowstorm, which was here, there and everywhere. Some suggested the postponement was made to give the city officials a chance to remove "the beautiful," so that one could go anywhere. The next paper considered was that by Mr. F. J. Rutledge, whose theme was "Lighting and Fuel Maintenance," which was followed by a rousing good discussion. The lecture on "Illumination," profusely illustrated by lantern slides, by Mr. Norman Macbeth, which was in that gentleman's best vein—and that is saying much—brought the day's business session to a close. We are about ready for the banquet at the Somerset to-night, where we expect quite a lot will be doing.—W.

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THE BANQUET.—The banquet hall was in the handsome Hotel Somerset's "best room," and the guests convened at 8 P.M. Wednesday evening. The feast proved a greater magnet than thought for. In fact, extra tables had to be impressed and placed so that the 400-odd who filed into the banqueting hall could be served. It was surely a happy gathering, and democratic as well, and the zeal with which the food numbers were attacked and secreted spoke well for the cleverness of the Somerset's *chef*. The after-dinner speeches might better have been designated sermons, to judge from the expounding of platitudes and praises. Artful compliments were passed around amongst the speakers, concerning each other and the Association, by Messrs. Wrightington, Richards and Doherty, whereupon and whereafter, the band introduced the real Mr. "Kelly," perhaps the original. His wit certainly is the latter, and his terse quips relieved the tension to such an extent that many grew positively joyous. More in the same vein followed, from our own Mr. Clark (is it necessary to add "W. J."), which called for "curtain," and sent the diners away in happy mood.—O.

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BOSTON, MASS., December 8, 1910.

Dear JOURNAL: Only one business session was held to-day—a morning one. It was notable for a very well set and described series of lantern slides, illustrative of several noteworthy (in that they are unusual) installations of machines using gas for industrial purposes. This was really supplemental to the paper and discussion of yesterday on industrial fuel. The other number was the paper by Mr. Henry L. Doherty, on "Rates." Student he ever was, nor have his studies been in vain. Far from it, since these have resulted in much of positive good to the complete field of the industry; and it is a satisfaction to here note that, even though years are sparing him no more than are others spared, they are in no sense dulling his perceptive senses. The paper on "Rates," complex subject that it is, will often be consulted in the days to come. The discussion on the Doherty paper concluded the technical business of the day. The afternoon was spent in sightseeing, the main feature of which was an automobile journey (about 40 machines were in line) over the route known to the denizens of Boston as the "Historic Trip." The snow made the outing part of the Convention not altogether a pleasure unalloyed; but it did not interfere with the theater sessions and generously pleasant minglings of a social character within the shelter of Boston's many beautiful hotels. The programme for to-morrow looks rather lengthy, but the assurance is that it will be cared for in regular order without resort to rushing. The story of that day, however, will have to be told in "our next." Meanwhile the gas show continues to attract the attention of the public, who are visiting it in large numbers.—W.

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CURRENT MENTION—

OUR correspondent, "J. M. B.," writing from Los Angeles, Cal., under date of the 1st inst., forwards a recent issue of a local paper from which we glean that, on the 29th ult., the Bakersfield (Cal.) Gas and Electric Company signed a contract with the California Natural Gas Company under which it is agreed that natural gas from the Midway oil fields will be piped to Bakersfield the last week in the current month. It is also worthy of note that the name of the Domestic Gas Company, of Los Angeles, has been blotted out, in that all of its possessions are now in the ownership of the Southern California Gas Company, which is a $10,000,000 corporation, owned by the Pacific Light and Power Company, which also owns the San Joaquin (Cal.) Light and Power Corporation. The parent Company has a large amount of capital at its disposal and will make many new extensions. For instance it is agreed on to expend at once not far from $150,000 in high pressure extensions to the existing system of the former Domestic Gas Company in Los Angeles. In addition thereto it is all planned out to stretch a high pressure line reaching out about 86 miles, going into territory as far east as Redlands, Riverside and San Bernardino. Our correspondent further notes: "Since we acquired this property (Bakersfield) some 4 months ago, we have had designs on the natural gas situation in the Midway, which I believe will eventually prove one of the greatest gas fields in the world. I will be very glad to write you more fully on this subject at a later date, if you care to have a story on natural gas in California, for I am now gathering all the data in reference to the same. * * * I am very much delighted with the project, Bakersfield being the first one to distribute natural gas on the Pacific Coast in large quantities. There are other places where both natural and artificial gas are served, but on not nearly so large a scale and with such a positive burning of bridges. We will shut down our artificial plant entirely and will have the natural gas service ready for avail not later than the 1st prox."

THE Light, Heat and Power Corporation, of Boston, has completed a 3-mile extension of high pressure gas main for the Worcester County Gas Company, from Palmer to Monson, Mass. Further extensions will be made next spring. In connection with the foregoing it seems timely to note that the above named Corporation is building a new gas plant at Palmer for the Worcester County Gas Company. The buildings are all completed and the machinery and piping are being installed.

THE Directors of the Fall River (Mass.) Gas Company, at a meeting held the last week in November, authorized the Company to announce a reduction of 5 cents per 1,000 cubic feet in the selling rate, the cut to become effective February 1st, 1911. It was also determined to declare an extra dividend of 15 per cent., payable the 22d inst.

THE new office quarters of the Milford (Mass.) Gas and Electric Light Companies were opened to the public the morning of the 1st inst. The shops are in the building known as the "Burns' Block," and no more attractive counting house and showrooms can be found in beautiful Milford. Mr. C. E. Lasher is in charge.

ANOTHER Massachusetts business center in which gas is to be reduced 5 cents per 1,000 cubic feet is Lowell, as per notification made to the city authorities by President Motley, under date of the 30th ult. The reduction becomes effective April 1, 1911, after which date the net rate will be 85 cents per 1,000, instead of 90 as at present. By-the-way the Company has renewed its contract with the municipality for the street lighting, the agreement calling for about 1,200 Welsbach lamps, at the very low figure of $22.75 per lamp per annum. The contract is for a period of 5 years.

A CORRESPONDENT in Fort Worth, Tex., writing under date of the 3d inst., says: "It is almost a pleasure to pay your gas bill in the handsome, new offices that have been established by the Fort Worth Gas Company in the Langever Building opposite the City Hall. The building has been remodelled, refinished and equipped with modern office fixtures that are said to be excelled only by those in two of the city's banks. Potted plants are tastefully placed at appropriate points in the office quarters. There is nothing frigidly formal about the place either, the door to the private quarters of the several officers carrying the somewhat homely invitation, 'Butt right in!' 'We've Got Gas to Burn,' is another sign that appears on one of the windows, which slogan is being spread extensively by Manager O. K. Shannon (and he is O. K.) in exploiting the advantages of gaseous fuel. With the installation of ornamental lamps of the Welsbach type the offices are amongst the handsomest, and amidst the most attractive surroundings of which the city can boast. The location of the new quarters, so far as the convenience of patrons is concerned, could not be surpassed."

THE Philadelphia Suburban Gas and Electric Company, of Chester, Pa., has engaged Mr. Edward F. Davis to act as its industrial gas expert. Mr. Davis was formerly on the commercial staff of the Atlantic City (N. J.) Company.

## Outdoor Lighting in England.—No. VI.

[By Norton H. Humphrys.]

It is scarcely possible to indicate the whole of the various ways in which outdoor lighting is applied, but for our present purpose it will be convenient to classify it as follows:

1. Alley, court, stair or passage lighting as applied to narrow ways or footwalks, say from 3 feet up to 8 feet wide.

2. Parade or promenade lighting as applied to wider and more important passages than No. 1, such as are to be met with at seaside resorts, public parks and pleasure grounds. They are for the most part confined to specially sheltered warm localities, because, as a general rule, sitting or loitering in the open air is impracticable on account of climate, except during a few weeks in summer. The word "Parade" also indicates a wide footwalk in front of an imposing row of shops. Sometimes the building is purposely set back, so as to leave a good vantage ground for showing off the contents of the windows. The whole row may be owned by one firm or syndicate, and it is very usual to provide lamps at regular intervals, carried on columns at the curb line or attached to the buildings. Or an ornamental frame may be included in the design, for carrying sun blinds, or stands for display of goods. The brilliant light is found useful in attracting the public to the locality, and an elegantly designed parade soon becomes a popular place of resort. This style of lighting involves somewhat different arrangements to ordinary street lighting, and as its object is to attract, it is usually carried out in the best style, and affords excellent facilities for introducing the latest improvements in lamps and burners. A good light is not only an excellent advertisement for shopkeepers, but also for gas.

3. Shop window lighting from outside. This is related to No. 2, and also affords excellent opportunities for introducing the best designs. It is an important department that is not adequately looked after in many districts, though from the frequent references to it in American serial literature I do not think there is much need to enlarge on its importance. It may include outside lamps with or without reflectors to divert the greater part of the light on the goods exposed to view, and with or without colored or lettered glass screens carrying advertisement announcements such as the name of the firm, or leading lines of goods. The latter is probably the most successful, because for one customer that is looking out for "Jones and Smith," there are ten who want the nearest place for obtaining some particular article. The name passes unnoticed, but the word "tobacconist" may remind the passer that he has used up the last remnant, and has nothing to smoke when he gets home. Such words as "post office," "good beds," "telephone," indicate frequent demands and are therefore much in favor. Outside lighting can also be pushed in old fashioned localities where the shops are small, low and so badly ventilated that extensive inside light is an objection. Outside light is also a great advantage where the goods are inflammable, or consist of jewelry, etc., that is readily tarnished, or specially valuable, and as such is shown in air tight cases.

The only really satisfactory plan, in any experience, is for the Gas Company to provide the lamps at a moderate annual charge, to include maintenance, and to retain the entire control. It means some outlay of capital, some care to avoid accumulating half used and valueless stock, and some continual expense, but the result is well worth while. I know of no town where this department has been properly attended to and where at the same time the general sales of gas are unsatisfactory or show a falling. Gas engineers frequently say that there is nothing like selling right out. It keeps down capital outlay and the consumer is more likely to continue to use the lamps. This is quite right. He does continue to use them—till they fall to pieces. All is well so long as the lamps are new, but when they begin to wear there is trouble. He expects them to be kept in efficient order long after they ought to have been scrapped, and a number of lamps in bad condition will spoil the whole show. This objection applies equally, whether the purchase is for cash on the nail, or by instalments. I have also met with the objection that with plain hiring the consumer is apt to want to change at frequent intervals and to have the latest improvements. This matter cuts both ways. It involves additional expense and perhaps a larger scrap heap. But it is not to the interests of the gas industry if a lot of old-fashioned, inferior lamps are maintained in use, especially in the face of competition. The money spent in providing the latest and best is not altogether money wasted. There is always the difficulty about undertaking the maintenance of lamps or anything else that belong to the consumer, that he objects to the cost of a second new lot when the first is worn out. With plain hiring, no disputes need arise, and there is nothing to disturb that harmony between seller and buyer that is such a necessary feature of present day methods of business.

In these matters there is too much blind copying. There is nothing lost by knowing the methods that have proved successful elsewhere; but success is rather to be found in some intelligently adapted scheme to meet the particular needs of each district, rather than in following the lead of neighboring towns. Every district has its special idiosyncracies, and the most successful man is the one who can clearly discern his opportunities and work them to the full.

4. Lane lighting, comprising thoroughfares not exceeding 20 feet in width and having a narrow footway on one or both sides.

5. Road lighting, referring to thoroughfares 20 to 40 feet in width, with a footway on each side.

6. Street lighting, including principal thoroughfares, approaches, etc., more than 40 feet wide.

7. Avenue lighting, for thoroughfares embellished by rows of trees along the curb line, one or both sides, which call for special treatment on account of the obstruction in a longitudinal direction, caused by the branches and leaves. Avenues are exceptional rather than usual in England, and the remark on climate, made under No. 3, applies equally to them.

If we were also considering lighting on the Continent of Europe it would be necessary to say something about the boulevards that are to be seen in all the principal cities and which extend 200 feet or more in width. A typical thoroughfare of this order will have 3 road tracks and 4 footways, and perhaps a special run for motors and bicycles. There will be a wide center carriage way, with a wide footwalk on each side, flanked by one or two rows of trees. Inside these, on each side, there will be narrower road tracks for the use of the houses immediately adjoining, and for rough traffic, such as coal carts, goods delivery vans, etc., and outside these again there will be footwalks in front of the houses. One or two examples of boulevards are to be seen in this country, but are so exceptional that no further reference to them is called for.

8. Square or open space lighting, such as the clearance in front or around an important public building, an open air market or an important railway depot.

Nos. 2, 6 and 7 may be absent in some of the smaller towns, but as a rule examples coming under all the heads mentioned are to be met with.

Until recent times there was a slavish adherence to the old-fashioned lantern with sloping top or roof, but the extended use of parade and outside shop lighting has directed prominent attention to the superiority of the suspended form of lantern, as compared with one supported from below, and to the advantage of curved glass as against straight sides. While flat flame burners were usual there was considerable excuse for adhering to the 4-poster pattern, because with that form of burner there is always a liability to fracture. The flame gets irregular in shape from one cause or another, causing local heating of the glass, and a sudden driving shower, coming after the lantern has been thoroughly warmed up, would cause breakage. With incandescent burners, however, this trouble disappears, and the consumption of glass is much reduced. The saving in this direction will go a good way towards paying for mantles, because there is absolutely no breakage except that due to occasional accident or mischief. Curved glass is more costly and frequent renewals are a serious item; but with incandescent burners the use of lanterns that are round in cross section, and not square, or of egg, oval or pear-shaped glasses, made in one piece, becomes quite feasible. The suspended light does away with the shadow immediately below the flame thrown by the bottom of the lantern, and this advantage has been so far recognized that suspended lamps are being attached to existing posts, and all the leading makers list patterns of curved pipes or square necks for this purpose. The suspended lamp is more readily attached to wall brackets, and this is a great consideration in narrow or crowded streets.

The difficulty with bracket lamps for public lighting is the supply pipe. In parade or outside lighting the supply pipe is carried up inside the premises of the user. But there are reasons why it is not desirable to carry the pipe for the public lamp inside the house, even if the occupier is agreeable. In 99 cases out of 100 he is not. The pipe must, therefore, be carried up outside, where it is always more or less an eyesore, and in variable climates a low or a changing temperature will cause stoppages in the pipes. This difficulty about the supply pipe has led many gas companies to use columns exclusively.

Some claims have lately been put forward on behalf of center lighting, the lantern being suspended over the center line of the thoroughfare by means of a steel cord stretched from house to house. There are so many objections to this plan that it is never likely to find general favor. The lights must be a considerable height so as to be well clear of traffic, and this almost necessitates a means of wiring them to the side for cleaning and other attention. A portable tower carried on a van would be too much of an obstruction. While capable of limited use in passages or lanes carrying no great traffic, they seem out of question for wide or long streets. The off side of vehicles

would be in shadow, and a lofty vehicle, such as a decker trolley car, would throw a shadow right across the footwalk. It is extremely awkward, not to say dangerous, to enter or to leave a vehicle if one cannot clearly see the steps. The great objection is that the light is not most needed in the center of the road but on the footwalks. There can be no question but that the proper place for the lights, in a thoroughfare over 20 feet wide, is the curb line. This involves a double row of lights. But a single row along the center line must be very much more powerful to give an equal effect, even when the ground is clear, apart from the obstruction caused by vehicles.

Very often it is possible to utilize posts or columns that are erected for other purposes, such as sewer ventilators, telegraph posts, overhead trolley wire carriers, etc., that are arranged at regular distances along the curb line. These offer every facility for carrying suspended lights, and an excellent effect can be obtained in thoroughfares of sufficient importance to warrant the expense, by arranging the lights in pairs, one on each side of the column, or in threes, where required for square lighting.

[Communicated.]

## The Doherty Gas Calorimeter.

Under the unprecedented growth of gas as a heating and cooking agent, even threatening its supermacy as an illuminating medium, the calorific value of gas has become of even greater importance than its candle power. The trade has in consequence felt the need for some means of testing the heating power of the gas it handles, and the "Doherty Gas Calorimeter," the invention of Mr. Henry L. Doherty, is the latest device placed upon the market for this purpose.

One distinguishing feature of the Doherty calorimeter is the fact that it is a self-contained unit, combining within itself the functions of meter, calorimeter and all the other accessories required in making a calorific test. The principle upon which it operates is the heating of a volume of water by a gas flame, the rise in temperature of this water being the measure of the heating value of the burning gas. Its distinctive feature, as compared with other gas calorimeters, is that the ratio between the volume of gas burned and the volume of water heated is maintained constant, by an arrangement under which the water, after being heated, displaces the gas under test.

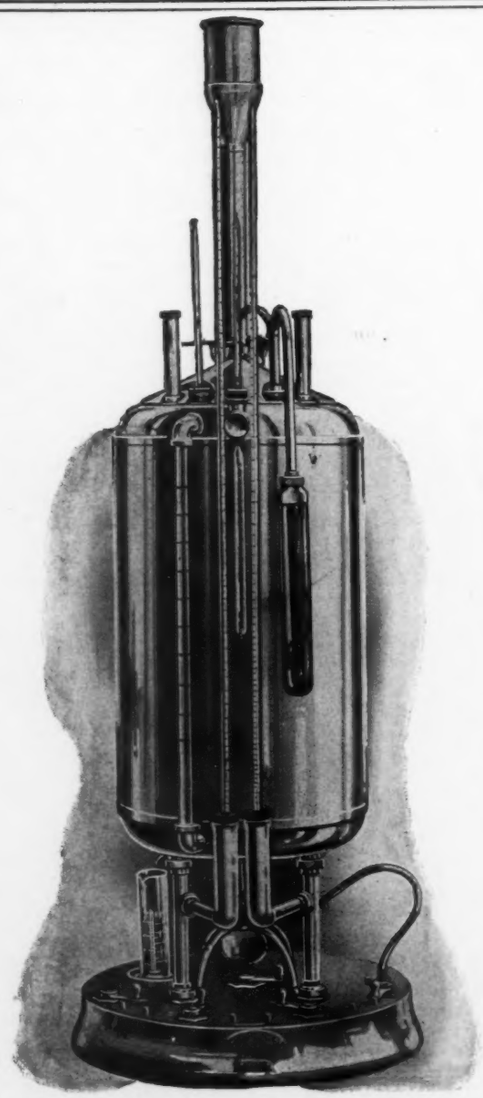
The Doherty calorimeter consists essentially of two parts: The absorption chamber, within which the gas is burned and the water heated, and the tank, which is filled with the gas to be tested, and into which the heated water from the absorption chamber flows. This water enters the tank at the bottom forcing the gas out at the top. The pressure upon this water (which is furnished by a hydraulic "head" in the regulator) is constant, and is the pressure imparted to the gas being burned. For every unit volume of water heated in the absorption chamber an equal unit volume of gas is displaced and burned to heat that water.

A British Thermal Unit (B. T. U.), it will be remembered, by definition, is the amount of heat required to raise 1 pound of water 1° F. in temperature, from an initial temperature of 39.1° F. The determination of the calorific value of a gas, therefore, in B.T.U.'s, consists in determining the amount of increase in temperature which the burning of a given volume of that gas will produce in a given weight of water. This has heretofore involved the accurate metering of the gas, the accurate weighing or measuring of the water, and the accurate determination of the difference in temperature produced in the water by the burning gas.

In the Doherty gas calorimeter the first two of these three functions (or elements) in the equation are eliminated by maintaining the ratio of volumes of water and gas absolutely constant by the displacing of the latter by the former in the calorimeter itself. A calorimeter test with the Doherty calorimeter accordingly becomes simply a matter of measuring two temperatures.

In operation, connection is made from a source of gas supply to the calorimeter tank; another connection is made from a water supply to the calorimeter regulator; and a third connection conducts away the overflow water from the regulator. The regulator consists of three concentric pipes, rising to a height slightly above the top of the tank. Water passes up through one pipe to the top and there overflows, part of it entering the middle pipe, which is a standpipe giving a constant static head or pressure on the tank. The remainder of the water flows to the waste pipe.

The tank, which is annular in section, surrounds the absorption chamber, also annular in section, the two being thoroughly insulated



from each other by a thick layer of felt. The gas is burned in Bunsen burner within the absorption chamber. There are five thermometers on the calorimeter, the two most important of which are tested by the U. S. Bureau of Standards, and the correction sheets for these thermometers is furnished with the calorimeter. The five thermometers measure the following temperatures: Initial temperature of water; final temperature of water; temperature of air surrounding the calorimeter; temperature of the gas in tank; and temperature of waste products of combustion. A pressure U-gauge on the side of the tank registers the pressure on the gas under test; and in making a test it is intended to keep this pressure about that of 2.6 inches of water.

A means is also provided in the absorption chamber for adjusting conditions so that the products of combustion will emerge toa tmo sphere at atmospheric or room temperature.

In making a test the tank is filled with gas from the gas supply, the latter then being shut off. Water from the regulator standpipe is turned into the tank, ready to displace the gas, first flowing through the absorption chamber. Adjustments are provided so that the gas pressure can be kept within the desired 2.6 inches of water. The Bunsen is lighted and the water flows through the absorption chamber, being heated as it passes, and expelling the gas from the tank. A gauge glass on the side of the tank shows the water level; and 10 marks are provided, so that temperature readings can be taken at 10 equal intervals, the average being employed as the basis of computation. When all the gas has been expelled from the tank, the burner goes out and the water automatically traps itself from overflowing into the gas pipe.

The computations necessary in determining the result of a test with the Doherty gas calorimeter are as follows, the various symbols being as here designated:

V = volume of gas corrected to 60° F., and 30 inches of mercury.
h = barometric pressure, in inches of mercury, at time of test.

$h^1$ = U-gauge pressure on tank, in inches of mercury.
a = vapor tension, in inches of mercury.
t = temperature of gas in tank.
d = difference in temperature of water before and after heating.

$$V = \frac{17.64\,[(h + h^1) - a]}{460 + t}$$

$$\text{B.T.U. in gas} = \frac{62.5 \times d}{V}$$

All of these values can be observed on the calorimeter itself, except "h" and "a." The value of "h" at time of test can be secured from a barometer at hand, or on application to some local barometer of known reliability. The value "a" is secured from tables furnished with the calorimeter and is determined from the temperature of the gas in the tank. The value "$h^1$," as read on the U-gauge, is in inches of water. Multiplying this by 1/13 (or .769) gives the corresponding pressure in inches of mercury.

This method gives the gross heating effect of the gas under test; but it does not take account of the latent heat represented by the water of condensation produced in burning the gas. To provide for this, and to determine the net heating effect of the gas, a graduate, marked in C.C. and also in B.T.U., is provided beneath the absorption chamber. When the water level in the tank is at the lowest of the 10 graduation marks on the gauge glass, the amount of condensed water in the graduate is noted. The distance between lower and upper gauge glass marks represents ½ of a cubic foot of tank displacement. When water level has reached the top mark, the added amount of water of condensation in the graduate, read in B.T.U., shows the amount of heat given up by this water. Multiplied by 3 (for ½ of a cubic foot of gas was burned), this gives the B.T.U. per cubic foot of gas represented by the water of condensation. Subtracted from the gross result, this gives the net heating effect or calorific value per cubic foot of the gas under test.

The Doherty gas calorimeter, as manufactured by the Improved Equipment Company, of New York, has many features which appeal strongly to the gas man. Among them may be mentioned simplicity and compactness. There is nothing about it to wear out. Highly finished throughout, in nickel, and contained in a mahogany case, it is ornamental and attractive in appearance. The manufacturers guarantee its accuracy and, as already stated, the thermometers for measuring temperature of inlet and outlet water are tested and corrected by the U. S. Bureau of Standards, a calibration sheet being furnished for each.

Each instrument is carefully tested by the builder before shipment and calibrated for accuracy by comparison with several other calorimeters of known correctness. As the only chance for error in this instrument is in a possible leakage, especial care is taken in manufacture to guard against this, and a careful test is made of each calorimeter to prove that there is no leakage. The Doherty gas calorimeter goes from builder to buyer in perfect condition and, where properly handled, affords results which can be relied upon.

[Official Report—As Appoved by Committee on Publication.—Continued from page 1088.]

## THE FIFTH ANNUAL MEETING, AMERICAN GAS INSTITUTE.

Held in New York City, October 19th to 21st (Inclusive), 1910.

First Day, Wednesday, October 19th.—Afternoon Session.

The President—We will now hear the paper, by Mr. J. M. Morehead, of Chicago, on the

### DETERMINATION OF THE CALORIFIC VALUE AND OF OPERATING CONDITIONS FROM ANALYSIS OF INDUSTRIAL GASES.

*Scientifically*, the word gas is used to distinguish any substance existing in a permanently elastic condition, as distinguished from other substances existing in either of the other two ordinary natural states of matter. Viz.: Liquid and solid. A permanent or fixed gas is one which cannot be reduced to the liquid or solid state by pressure alone. A gas which can be liquefied by pressure, at ordinary temperatures, is usually called a vapor.

*Ordinarily*, the word gas is used to designate any substance, or combination or mixture of substances, not a solid or a liquid which cannot be touched or seen, and all substances or mixtures having these two characteristics are included under the one general term gas. As a matter of fact gases present far more diverse physical and chemical characteristics, and differ much more widely among themselves, than do either solids or liquids. For examples of these striking differences see Appendix B.

*Industrially*, the word gas is restricted to substances which are used for burning for either light, heat or power, and while we speak of illuminating gas or of fuel gas we must remember that any industrial gas is a complex mixture of a number of diverse constituents. There may be a vast difference between one gas and another gas, and there is a possibility of even vaster differences between mixtures of gases when the mixtures are made up of a number of constituents, and the nature of any such mixture can be profoundly affected by changes in the relative percentages of its component parts.

The importance of an analysis of the many forms of gas, either produced or consumed in ordinary industrial processes, is not thoroughly appreciated. If the great economic value of the light shed upon the condition of the machines, the fires, the retorts, the furnaces, the engines, or other gas making or gas using apparatus by a gas analysis were better understood, and if the simplicity and economy of the apparatus, and the ease of the process of analysis, were more apparent, this form of research and this aid to station operations would be more nearly universal.

The photometer will tell a superintendent the fact if his product is not up to standard in light giving power; the calorimeter will tell him that the heating power is not up to standard, but the discussion of the chemical analysis, and the study of the data thus obtained, and only these, can tell him the reasons for the facts of which the other two processes of investigation assure him. Neither one of these methods of investigation and checking can take the place of the other two. The photometer will quickly make it plain if the luminosity falls off, but this is a consequence, not a reason; so, also, the calorimeter will say this gas is deficient in heat value, but only the chemical analysis and its intelligent study can give the reasons why, of either or both of these unfortunate facts.

A deficit of air in boiler firing will result in the incomplete burning fuel to carbon monoxide, and the production of 4,500 heat units to the pound, instead of to carbon dioxide and the production of 14,500. An excess of air will overflow a fire, dilute and chill the flue gases and cause the needless heating of large quantities of air which escape up the stack. Too much or too little air will often cause boilers to work at a lower efficiency than can be offset by superior fuel, patented grates, damper regulators or high-priced settings. An analysis of chimney or flue gas will tell definitely and accurately the conditions as to the air supply of a boiler.

An analysis of the exhaust from a gas engine will tell whether there is too little air, with incomplete combustion which lowers the efficiency of the engine and affects the power bill, or whether there is an excess of air which takes the place of the mixture of gas in the cylinder, and thus lowers the available horse power.

In gas works, in iron and steel plants, with gas producers, in all forms of furnaces and for ventilating purposes, an analysis of the gas will give information upon the condition of the apparatus, will detect leaks of air or gas, and will serve as an index to the character of the changes taking place inside of the apparatus. All of which knowledge can be turned by the manager to most advantageous economical account.

From answers received to 220 inquiries, in regard to gas analysis, sent to those gas companies in the United States and in Canada having a daily sendout of 250,000 or over, and to the principal gas engine and gas producer manufacturers, it is clear that gas analysis receives very little attention, especially in the smaller companies; and, even among the larger ones, the methods, apparatus and constants vary very widely.

One hundred and four answers were received. Only one company declined to give any information. About one-third reported that they had no information along the lines asked for, the balance returning more or less complete answers.

From the answers received, 31 analyze some sort of gas regularly, 21 occasionally and 52 not at all. The distribution of analysis, either regular or occasional, was as follows, there being, of course, a number that analyze more than one kind of gas:

| | | | |
|---|---|---|---|
| Flue gas | 36 | Water gas | 34 |
| Coal gas | 33 | Mixed gas | 24 |
| Producer gas | 10 | Natural gas | 6 |
| Engine exhaust | 6 | Pintsch gas | 5 |
| Oil gas | 4 | Air | 2 |
| Furnace gas | 2 | Acetylene | 1 |

Thirty-eight of the 57 companies analyzing their gas use the results

obtained as an aid in their station operations; just why the other 19 make the analyses does not appear. Fifty-seven companies determine the calorific value of their product. Of these, 46 use Junker's calorimeter, 10 the Sargent and 1 the Doherty. Forty-seven companies do not use any calorimeter.

Thirty-eight companies calculate the calorific value from their analysis; 74 do not. The constants for the calculations were:

| | Highest. | Lowest. | Average. |
|---|---|---|---|
| Illuminants | 2,257 | 1,621 | 1,888 |
| Carbon monoxide | 350 | 317 | 333 |
| Hydrogen | 350 | 319 | 334 |
| Methane | 1,600 | 915 | 1,054 |

The average agreement between the calculated and the determined B.T.U., by those who arrived at the calorific value both ways, was 3.75 per cent. This emphasizes the importance of some authoritative action on the part of such an Association as this looking towards some sort of standardization.

The chemical and physical examination of gas is in and constitutes a branch of chemistsy and of physics peculiar to itself. The very nature of the gas business makes the requirements peculiar. In other branches of analytical chemistry there is always some stock of material on hand from which a second sample can be drawn, or a check analysis of the sample already taken can be made; but, under ordinary conditions, there is never any considerable stock of gas on hand, and to have any value at all a gas analysis must be finished and reported within a very few hours of the time when the sample is taken. Otherwise the gas of which the sample was a part is gone, and while the results may have some interest as a record of what the plant *has* done, it can be of no value as an indication of what the plant *is* doing, and to have such value a method which can be carried out in a short time must be available, and dispatch in the performance of the analysis is an essential.

There is practically only one method of gas analysis. This, which was worked out many years ago by Bunsen, Hempel and Winkler, consists in the successive absorption with different chemicals of the various constituents of the gas. Various modifications of this method are used with the different types of apparatus now employed.

The principal designs of gas analyzing apparatus may be grouped into two classes. First, those which keep the reagents in what may be called a stationary position and pass the gas through the reagents, using the same chemicals over and over; and second, those which keep the gas in a stationary position and pass the chemicals through the gas, using the chemicals in this case only once. The apparatus of the first class has the advantage of greater economy in chemicals and is not so sloppy in use, but in the opinion of the writer these advantages are more than offset by the fact that the analyst never knows just when the solutions are exhausted below a point where they will give accurate results.

There can be no such uncertainty with apparatus of the second class, as fresh solutions are always being used and there is no responsibility of the chemicals having been weakened or exhausted by previous analyses.

All modern designs of gas analyzing apparatus come under these two heads and are modifications of what might be called these two standard types. In the first class is Hempel's apparatus (Fig. 1) which is perhaps the best known of the more accurate instruments. In experienced hands it gives excellent results, but the first cost is high, and, owing to the number of different parts, is liable to breakage. A complete analysis requires from 1 to 3 hours. It is made in various forms, consisting essentially of a measuring burette connected to a tube or bottle containing a liquid—such as water or mercury—and a series of absorption pipettes in which the gas is brought successively into contact with the various reagents. By raising or lowering the leveling tube and manipulating the stopcock at the top of the burette, the gas sample can be drawn in or expelled successively passing into and being drawn back from the various pipettes, to be measured before and after the different absorptions. This type of apparatus has the advantage of being adapted to the use of mercury instead of water as a sealing material, if analyses of water free gas are to be made.

The Orsat-Lunge apparatus (Fig. 2) is a variation of the Hempel and a convenient form of apparatus for the rapid and partial analysis of gas. It can be had in a wooden box, with removable front and back, and a handle on top so as to be readily transported, and analyses can be made on the spot. It consists of a measuring tube of 100 cc. capacity, which is surrounded by a water jacket for keeping the temperature constant. The base of this tube is connected to a leveling

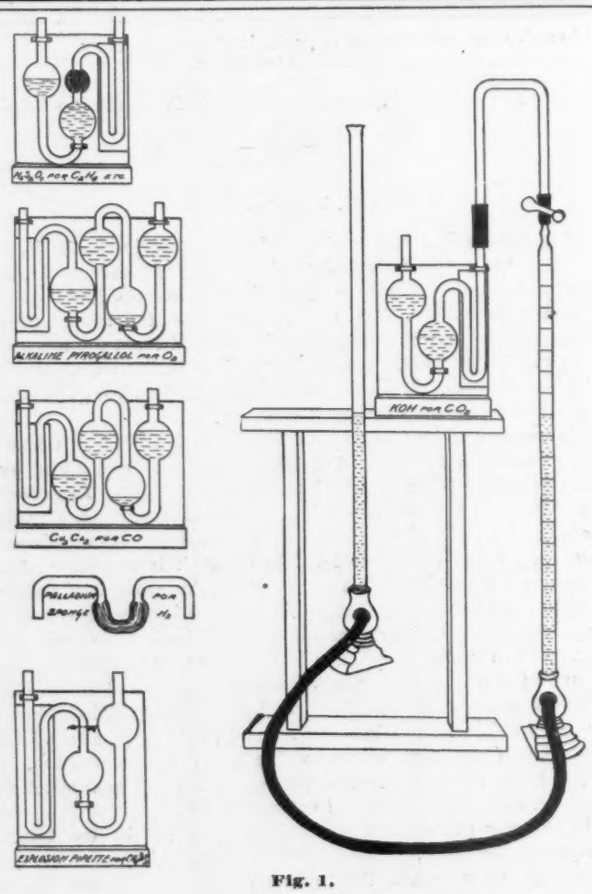



Fig. 1.

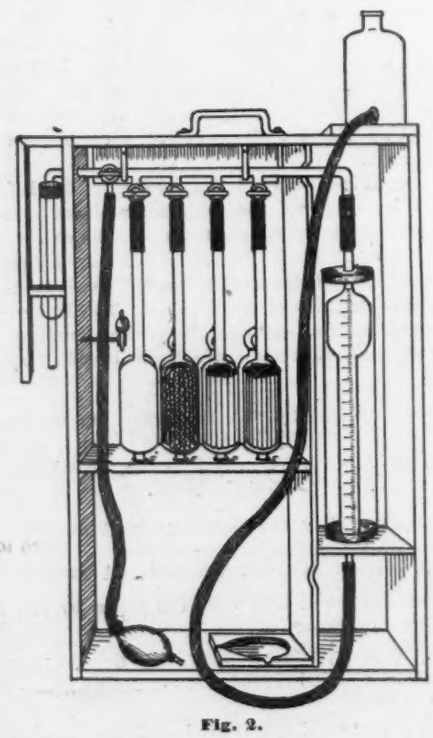


Fig. 2.

bottle, which is filled with water. The top of the measuring tube is joined by means of capillary tubing with three absorption vessels, which may be connected with, or shut off from, the measuring tube by means of stopcocks. The outlet of each of these vessels is connected with a similar vessel in the rear furnished with a tubulated exit, which in turn is attached to a rubber bag, whereby air is excluded, and the reagent may be driven back if necessary.

The first vessel contains caustic potash, the second alkaline pyrogallic acid, the third, acid cuprous chloride solution. In order to increase the surface exposed to the gas, each tube is filled with narrow glass tubes set vertically, while in addition to these the cuprous

chloride vessel contains pieces of copper wire to keep the solution reduced. In some forms of this apparatus there is a fourth vessel containing palladium sponge for the determination of hydrogen. The sample is measured and forced over into the vessel for absorption of carbonic acid, back to the burette for measurement, then into pyrogallic acid vessel for absorption of $O_2$, and back to burette, then into the acid cuprous chloride vessel for absorption of CO, from here into caustic potash vessel for the removal of acid vapors and thence to the burette, and so on. In its ordinary form the Orsat apparatus does not admit of the determination of methane and hydrogen, although some modern forms have an explosion pipette, and with this addition a complete analysis may be made.

In the second class the best known example is the Elliott apparatus (Fig. 3), designed by Dr. A. H. Elliott, of New York. In its original

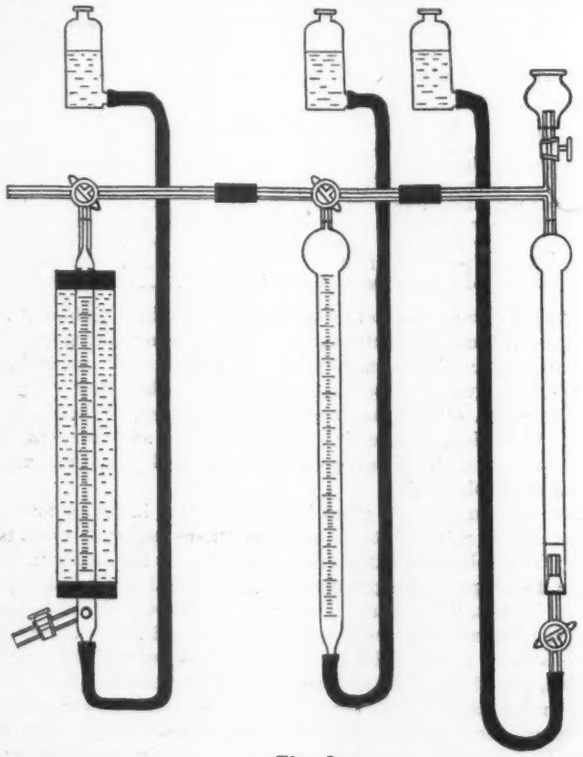


Fig. 3.

form, and with its various modifications, it is intended for the rapid and complete analysis of coal, water or flue gases, and is used to a very considerable extent. It is probably not as accurate as the Hempel, but much more rapid and less delicate, therefore, more suitable for rough work. It consists of three tubes, viz.; laboratory, measuring and explosion tubes. The measuring burette is surrounded with a water jacket, to insure constant temperature, and has a capacity of 100 cc. from the zero to the mark on the capillary tube, the graduations being in tenths of a cc. The gas is passed into the laboratory tube, then to the measuring burette to be measured, 100 cc. being taken. The reagents are introduced into the laboratory tube and the absorptions made in that tube, the gas being returned to the measuring burette after each absorption for measurement. After the use of each reagent in the laboratory tube the gas must be washed with water. The explosions are made in a third or explosion burette.

The Morehead apparatus (Fig. 4) belongs also to the second class, and consists of a single graduated, water-jacketed burette, which is also provided with explosion points. The measuring, absorption, explosion, in fact, the entire analyses, being performed in the one burette, without necessity for movement of the sample. This apparatus is quite simple in design, economical in first cost, requires little training for its use and is quite rapid. As there is only the one burette, the necessity of shifting the sample is obviated, and an entire analyses of seven determinations can be made in from 30 to 40 minutes. Results obtained by different sets of this apparatus in the hands of different analysts working on the same gas, or results obtained by the same analyst working at different times on the same gas, are quite consistent, and the calculations of calorific value from analyses made with this apparatus agree remarkably close with determinations of the calorific value made with a Junkers calorimeter.

It is not the intention of this paper, nor is it within the scope, to

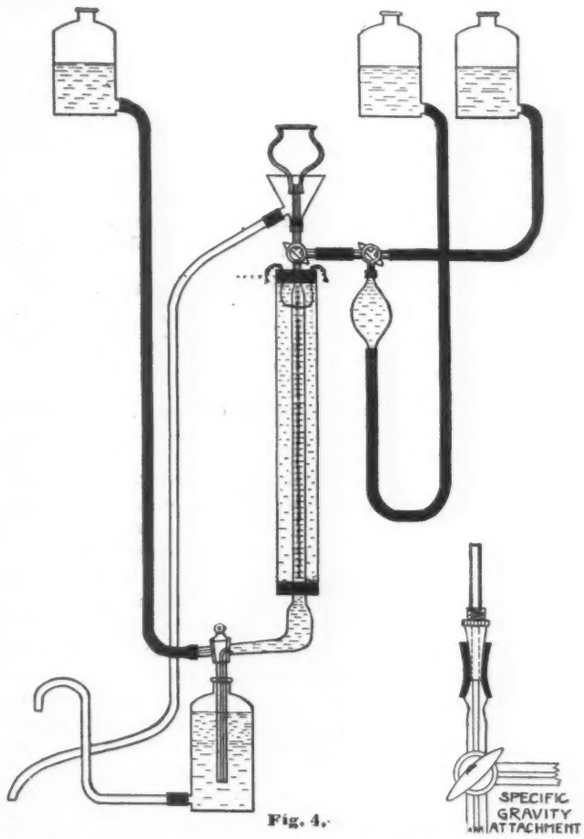



Fig. 4.

suggest different lines or methods of gas analysis, or to suggest changes in the existing practice where such practice exists, or to draw comparisons between different designs of apparatus. There is practically only the one method, and it is quite sufficient. With any of the modern types of apparatus consistent and valuable results can be obtained.

The object of this paper is to call attention to the value of gas analysis and to emphasize the importance of consistently carrying it out. It is hoped by means of the explanations to enable gas men of average intelligence, but without special analytical training, to analyze their product; and, further, to simplify the manipulation and shorten the time so that the analysis of any gas may be incidental to a superintendent's daily work, and not the special duty of someone set apart for this purpose. Also, to furnish data and tables for the calculation of the heating value and for the intelligent interpretation of the results obtained from the analysis. In a word, to call attention to a most important but much neglected field of chemistry intimately related to the gas industry.

### Constituents.

By analysis industrial gases are usually divided into their seven constituents, as follows, the order in which the constituents are given being that in which the determinations are made:

| | |
|---|---|
| Carbon dioxide | $CO_2$ |
| Illuminants | Ill |
| Oxygen | $O_2$ |
| Carbon monoxide | CO |
| Hydrogen | $H_2$ |
| Methane | $CH_4$ |
| Nitrogen | $N_2$ |

These constituents exist in varying, and in widely different, proportions in different industrial gases, and in the same industrial gas proportions vary from day to day and with every change of operation of oil or fuel or of material. The characteristics of these constituents vary widely, but they may be grouped into a number of classes. Three of them—$O_2$, $H_2$ and $N_2$—are chemical elements, two—$CO_2$ and CO—are combinations of C and O; two—$CH_4$ and the Ill—are a combination of C and H. Five of the seven—$O_2$, CO, $H_2$, $CH_4$ and $N^2$—are permanent gases, one—$CO_2$—is usually termed a gas, but as it can be liquefied at ordinary temperatures it must be classified as a vapor, while one—Ill—consist of part permanent gases and part vapors. Four of the seven—Ill, CO, $H_2$ and $CH_4$—contribute all of the lighting and heating value, while three—$CO_2$, $O_2$ and $N_2$—will

not burn, are direct impurities and detract from the thermal and illuminating value made up by the other four. Of the four—Ill., CO, $H_2$ and $CH_4$—which form the bulk of a gas and give it its value, two—CO and $H_2$—burn with a rather low heating value and no light; one—$CH_4$—contributes very largely to the heating value but does not raise the candle power, while one—Ill.—increases the heating value and contributes practically all of the open flame illuminating value.

Separately considered, these constituents exhibit the following principal characteristics: All figures given are for dry gases at 60° F. and 30 inches of mercury. The percentages are for volume, not weight, and, where the same applies, for combustion in air, not oxygen.

### Carbonic Acid or Carbon Dioxide.

| | |
|---|---|
| Formula | $CO_2$. |
| Composition by weight | 72.73° O 27.27 C. |
| Density or specific gravity, air = 1 | 1.519 |
| Pounds per cubic foot | 0.1162 |
| Cubic feet per pound | 8.606 |
| Cubic feet air necessary to consume 1 cubic foot | Non-combustible. |
| Gross B.T.U. per cubic foot | Non-combustible. |
| Solubility, vols. absorbed in 1 vol. water | 1.005. |

Carbon dioxide or carbonic acid is one of the commonest of all gases. It is the product of combustion, of fermentation, of decay, of putrefaction, or of animal or human respiration in the presence, if not of an excess, certainly of a sufficiency, of air or of oxygen. Carbon dioxide occurs in the air to the extent of about 5 parts in 10,000, unless the air is polluted; then the proportion is higher. $CO_2$ is the gas which absorbed in water gives soda or sparkling water. It is also the "after damp," "choke damp" or "black damp" found in mines after an explosion. While small quantities of this gas are not poisonous, and may be taken into the stomach or into the lungs with impunity, 0.1 per cent. of $CO_2$ in air is about the limit for breathing with comfort, 5 per cent. will cause headache and languor, 4 per cent. to 6 per cent. will affect a candle flame, 8 per cent. to 10 per cent. will eventually cause death from suffocation, 12 per cent. to 15 per cent. will extinguish a candle flame.

In $CO_2$ the carbon has all of the oxygen with which it can combine; it is already completely burned and incapable of further combustion.

Carbon dioxide is an impurity, and its presence is a detriment to any industrial gas which is intended for further burning. Air added to the gas before the gas is out of the fire will increase the $CO_2$, or steam which passed through the fire will produce $CO_2$ in a water gas process by reaction with the CO. Its presence shows that some of the gas, or of the fuel, is already consumed, and in a way $CO_2$ in a gas is analogous to ashes in a coal pile. Owing to its high specific heat $CO_2$ will lower the candle power of illuminating gas between 2 per cent. and 4 per cent. for each 1 per cent. present.

Carbon dioxide is an acid and almost any alkali will absorb, neutralize or remove it. Potassium hydroxide is the best absorbent unless very small quantities of this gas are being dealt with, as in air analysis, or where extreme accuracy is required, when the more expensive barium hydroxide is to be preferred.

### Illuminants or Heavy Hydrocarbons.

| | | |
|---|---|---|
| Formula | Ethylene | ($C_2H_4$.) |
| Composition by weight | " | 85.62 per cent. C 14.38 H. |
| Density or sp. gr., air = 1 | " | 0.985 |
| Pounds per cubic foot | " | 0.074 |
| Cubic feet per pound | " | 13.38 |
| Cubic feet air necessary to consume 1 cubic foot | " | 14.34 |
| Solubility, vols. absorbed in 1 vol. water | " | 0.15 |

Illuminants is a term used to designate a group of different gases and vapors, and is unlike carbon dioxide, carbon monoxide, etc., which refer to single definite chemical compounds.

Illuminants are derived for the most part from the decomposition or "cracking," due to the moderate heating of organic compounds or mixtures, such as coal, petroleum, oils, fats, resins, etc., and, to a large extent, consist of so-called "unsaturated" compounds, or compounds which have the ability to unite or add to themselves certain elements or other compounds.

Heavy hydrocarbons are mainly dense and complex combinations of carbon and hydrogen, which, upon being heated, readily break up into hydrogen and relatively large amounts of carbon. The carbon set free by the illuminants in a gas flame is to a great measure the cause of luminosity or candle power of that flame. The heavy hydrocarbons are for the most part poisonous if inhaled or swallowed, but they vary so widely among themselves that no definite figures can be given as to the percentages which carry toxic properties. It may be said of them, however, that in their physiological effect they resemble the vegetable rather than the mineral poisons; *i. e.*, the effect is soporific or stupifying rather than violently active, as is the case of carbon monoxide or cyanogen.

Illuminants vary in percentage in any one gas, and differ widely in composition and in characteristics in different gases. The illuminants of a carburetted water gas consist mainly of ethylene with other members of the olefine series and various other complex hydrocarbons, existing either as gases or vapors. The illuminants will also vary in percentage and in composition in the same gas upon standing, on account of the fact that many members of the family in such a gas are vapors which gradually condense into liquid form and hence change the general quantity and nature of the residual mixture of heavy hydrocarbons.

Either turpentine, petroleum, olive oil, fuming sulphuric acid or bromine will each absorb illuminants and may be used for this purpose, but the last named is the most satisfactory. Acetylene behaves as an illuminant, and when it is pure bromine will absorb 100 per cent. of it.

### Oxygen.

| | |
|---|---|
| Formula | $O_2$ |
| Composition by weight | 100 per cent. $O_2$. |
| Density or specific gravity, air = 1 | 1.105 |
| Pounds per cubic foot | 0.0845 |
| Cubic feet per pound | 11.83 |
| Cubic feet air necessary to consume 1 cubic foot | Non-combustible. |
| Gross B.T.U. per cubic foot | Non-combustible. |
| Solubility, vols. absorbed in 1 vol. water | 0.039 |

Oxygen occurs free and forms 23.2 per cent. by weight and 20.8 per cent. by volume of the atmosphere, the rest being nitrogen, and it is the supporter of combustion and of animal and vegetable life. Straight oxygen of 100 per cent. purity may be breathed without deleterious effect, other than temporary giddiness and headache from over stimulation. While air containing as low as 7½ per cent. of oxygen, the remainder being pure nitrogen, will sustain human life. (See paragraph on air.)

Free oxygen found in gases in almost every instance comes from air which is mixed, intentionally or otherwise, with the gas, and when from this source it carries along with it four times its volume of inert nitrogen. The presence of oxygen itself is not detrimental to a gas; in fact, if the quantity of oxygen was not sufficient to carry an explosive hazard, its presence would be a benefit. A mixture of pure oxygen with gas would give a sharper, cleaner explosion in a gas engine, would have a higher candle power in an open flame burner, and a much higher flame temperature and candle power when used with a mantle than would the same gas without oxygen; but oxygen keeps very bad company, and of the fourfold volume of nitrogen with which it is always accompanied, and of whose presence it is an indication, not one single word of commendation can be said.

It is almost impossible to get any industrial gas absolutely free from oxygen. This element along with its partner may come into gases from air dissolved in the water, or in the oil used in the processes, or from air held in the pores or interstices of the fuel, bricks, carbide, purifying material, etc. The presence of considerable quantities of free oxygen, if accompanied by nitrogen in approximately the proportion of air, is always evidence of an air leak, or of the use of excessive quantities of air, though the absence of free oxygen does not necessarily imply that there is no such leak, because oxygen is so energetic that it may be absorbed, or if mixed before the gas is cooled below its ignition point, it will combine with hydrogen and disappear as water vapor, or combine with the carbon and appear as carbonic acid or carbonic oxide leaving the nitrogen.

A high percentage of oxygen is an indication of a leak after the gas has passed out of the hot parts of the process, or the use of too much air for purification, or for other purposes, or what is very often the case of carelessness in taking the sample or in performing the analysis. Oxygen may be absorbed by yellow phosphorus, or by an alkaline solution of pyrogallic acid, of which the latter is the better.

### Carbonic Oxide or Carbon Monoxide.

| | |
|---|---|
| Formula | CO |
| Composition by weight | 42.85 per ct. C 57.15 per ct. O! |
| Density or specific gravity, air = 1 | 0.967 |
| Pounds per cubic foot | 0.07394 |
| Cubic feet per pound | 13.53 |
| Cubic feet air necessary to consume 1 cubic foot | 2.38 |
| Gross B.T.U. per cubic foot | 323 |
| Solubility, vols. absorbed in 1 vol. water | 0.0256 |

Carbon monoxide or carbonic oxide found in gases comes from the incomplete combustion of fuel. If there is a sufficiency of air almost every fuel will burn to $CO_2$, water and ash, while a deficit of oxygen results in partial combustion of carbon to CO instead of incomplete combustion to $CO_2$. The CO thus produced is half-burned carbon and will burn to $CO_2$ if subsequently supplied with additional air or oxygen and ignited. CO is produced also, if a gas flame, either luminous or Bunsen, comes in contact with a cold or a sooty surface. CO is the poisonous constituent of gases, 0.05 per cent. being sufficient to cause giddiness, 0.1 per cent. will bring about inability to walk, 0.2 per cent. loss of consciousness and 1 per cent. will produce death after a few minutes of inhalation. CO, like hydrogen, is valuable principally on account of the volume which it gives to an industrial gas, and as a carrier for the vapors, etc., forming the illuminants. It possesses no candle power, but its 323 B.T.U. per foot contribute to the calorific value. In gases for burning, a high percentage of CO is evidence of good working conditions, especially if there is at the same time little or no $CO_2$. The best absorbent for carbon monoxide is a hydrochloric acid solution of copper monochloride.

HYDROGEN.

| | |
|---|---|
| Formula | $H_2$ |
| Composition by weight | 100 per cent. H |
| Density or specific gravity, air = 1 | 0.0692 |
| Pounds per cubic foot | 0.005321 |
| Cubic feet per pound | 187.9 |
| Cubic feet air necessary to consume 1 cubic foot | 2.39 |
| Gross B.T.U. per cubic foot | 326 |
| Solubility, vols. absorbed in 1 vol. water | 0.019 |

Hydrogen is a metal and is the lightest of all known substances. It does not exist free in nature. In industrial gases it is produced by the breaking up of water by hot carbon or by the excessive heating of some of the hydrocarbons introduced in the shape of oil or coal for the purpose of adding illuminants, or by the action of some acid on certain metals. Excessive temperatures in a gas machine will result in the breaking-down of any illuminant or other hydrocarbon into lampblack and hydrogen.

The presence of steam in the carbureter or superheater of a water gas machine, or of wet coal in a retort, will produce hydrogen by combination with CO according to the formula:

$$CO + H_2O = CO_2 + H_2.$$

Like CO, hydrogen adds to the volume of a gas and acts as a carrier of the other constituents. It is without candle power itself, but its 326 B.T.U. per cubic foot contribute to the calorific value.

Hydrogen is without physiological effect and probably stands next to nitrogen for inertness from this standpoint. There is no satisfactory liquid absorbent for hydrogen. To determine its percentage it is caused to burn in an excess of oxygen with which it combines to the extent of ½ its volume and forms water—$H_2O$— this condenses and from the contraction the percentage of hydrogen is calculated.

Hydrogen can be determined also by use of a palladium tube. This method has to be used where the gas has in addition to methane, ethane or other bodies of the methane series which have to be separated from the methane. It is also useful as a check on the other method, but for ordinary use it is too cumbersome and costly, requiring too long a time and too high a degree of analytical ability to make it preferable to the explosion method.

METHANE OR MARSH GAS.

| | |
|---|---|
| Formula | $CH_4$ |
| Composition by weight | 74.86 per cent. C 25 per cent. H |
| Density or specific gravity, air = 1 | 0.553 |
| Pounds per cubic foot | 0.04233 |
| Cubic feet per pound | 23.62 |
| Cubic feet air necessary to consume 1 cubic foot | 9.5617 |
| Gross B.T.U. per cubic foot | 1009 |
| Solubility, vols. absorbed in 1 vol. water | 0.0386 |

Methane or marsh gas in industrial gases comes from the distillation of oil or of coal at fairly high temperatures. This hydrocarbon is the active element of natural gas and of firedamp found in mines, and was probably produced at some remote geological period when measures of soft coal or oil deposits were subjected to excessive temperatures. It is produced in nature by decay out of the presence of oxygen or of air, such as the slow decay of animal or of vegetable matter under water, hence the name of march gas.

Methane is without physiological effect, and mixtures of it in air, up to even 45 per cent. to 50 per cent., may be breathed; and the discomfort experienced even then is probably more due to the want of oxygen than to the presence of methane.

After the illuminants have been distilled off of oil or of coal, or when the temperatures are too high for their production, methane is produced, or it may result from a partial breaking down of illuminants due to excessive temperatures which are not quite high enough to effect complete decomposition into lampblack and hydrogen. Methane, having a candle power of from 2 to 7, does not add especially to the illuminating value of a gas; but, owing to its high calorific value, it is of very great value in raising the B.T.U. of any gas in which it appears. There is no known absorbent of methane, but when this hydrocarbon combines with oxygen it produces its own volume of $CO_2$ which may be subsequently absorbed by KOH, and from the contraction the volume of methane originally contained may be calculated.

NITROGEN.

| | |
|---|---|
| Formula | $N_2$ |
| Composition by weight | 100 per cent. N |
| Density or specific gravity, air = 1 | 0.971 |
| Pounds per cubic foot | 0.07413 |
| Cubic feet per pound | 13.49 |
| Cubic feet of air necessary to consume 1 cubic foot | Non combustible |
| Gross B.T.U. per cubic foot | " " |
| Solubility, vols. absorbed in 1 vol. water | 0.015 |

Nitrogen is the dead, inert, effete or worn out member of the family of elements. It exists free in nature, forming 77 per cent. by weight and 79 per cent. by volume, of the atmosphere, the rest being oxygen. It is not poisonous, but will not support life or combustion. Straight nitrogen of 100 per cent. purity may be inhaled with perfect impunity until distress comes about from want of oxygen, or nitrogen may be swallowed or injected into the cavities of the body without effect. Nitrogen has only a few combinations with the other elements, and cannot be made to form these without a good deal of difficulty, and when it is in combination it comes out with great emphasis upon very small provocation. Practically all modern explosives consist of nitrogen, held in some form of unstable combination, and a dynamite, nitro-glycerine, guncotton or gunpowder explosion is nothing more or less than this element dissociating from some unwilling union.

Nitrogen is not effected by extremes of temperature, or by ordinary chemical reagents. It passes into the stomach or lungs of animals, or into the fire of the gas engine, gas furnace, or of a gas burner as nitrogen and comes out again as nitrogen. In the analysis of gases every other constituent is absorbed, dissolved or burned, and what is left unchanged, after the drastic treatment with a number of diverse chemicals and an explosion with pure oxygen, is nitrogen.

The presence of some nitrogen in gas is unavoidable, and like oxygen is usually evidence of air. Nitrogen, like other incombustible impurities in gas, lowers the calorific value just in proportion to its presence, but affects the candle power to a greater extent. It may come from the same sources as those mentioned for oxygen, or in coal or in water gas is left from the air added for purposes of revivification. As there is no practical absorbent for nitrogen it is determined by difference; the difference between the sum of the percentages of the other constituents and 100 is taken to be the percentage of this element. (See paragraghs on oxygen and on air.)

AIR.

| | |
|---|---|
| Formula | Mixture $O_2$ and $N_2$ |
| Composition by weight | 76.83 per ct. N, 23.17 per ct. O, |
| Density or specific gravity, air = 1 | 1.000 |
| Pounds per cubic foot | 0.07657 |
| Cubic feet per pound | 11.91 |
| Cubic feet air necessary to consume 1 cubic foot | Non-combustible |
| Gross B.T.U. per cubic foot | Non-combustible |
| Solubility, vols. absorbed in 1 vol. water | 0.0178 |

Air is a mechanical mixture of oxygen and nitrogen. It usually contains small and varying percentages of moisture, dust, $CO_2$ and other impurities, though not in quantities which may be detected without special apparatus and methods. An analysis of a typical sample of mountain, or of sea air would be about as follows:

| | Per Cent. |
|---|---|
| Nitrogen, $N_2$ | 78.35 |
| Oxygen, $O_2$ | 20.77 |
| Water vapor, $H_2O$ | 0.83 |
| Carbon dioxide, $CO_2$ | 0.05 |
| | 100.00 |

Deducting the $H_2O$ and $CO_2$ we wouid have:

| | |
|---|---|
| Oxygen by volume....20.96 per cent. | By weight...23.17 per cent. |
| Nitrogen by volume...79.04 per cent. | By weight...76.83 per cent. |

The ratios of the constituents by volume are:

| | | | |
|---|---|---|---|
| Vol. oxygen | × 4.77 | = | vol. air |
| Vol. oxygen | × 3.77 | = | vol. nitrogen |
| Vol. nitrogen | × 1.26 | = | vol. air |
| Vol. nitrogen | × 0.265 | = | vol. oxygen |
| Vol. air | × 0.791 | = | vol. nitrogen |
| Vol. air | × 0.209 | = | vol. oxygen |

No exact figures can be given which indicate definitely the proportion of the deficit of oxygen or the content of $CO_2$ in air at which point the air becomes dangerous to breathe.

If the oxygen is abstracted chemically, or pure $CO_2$ added, mixtures covering a very wide range indeed may be inhaled with impunity. But oxygen is almost invariably extracted and $CO_2$ added by some process by which other impurities are added at the same time, and these are very apt to render the air unfit for breathing before this condition would become evident from an analysis showing merely the oxygen, nitrogen and $CO_2$ content of the sample taken. From a hygienic standpoint, however, it is always wise to regard with grave suspicion any air showing from 0.5 per cent. to 2 per cent. of $CO_2$, or 5 per cent. less than the normal amount of oxygen, while air showing as much as 5 per cent. of $CO_2$, or any appreciable percentage of any other impurity, especially CO, is positively poison.

Air affects the calorific value of a gas as do other non-combustible impurities, just to the extent and in direct proportion to the percentage present; but, like the other impurities in the same class, it affects the candle power to a far greater extent. Comparatively low candle power illuminating gases, such as coal gas of about 16-candle power, suffer more from an air admixture than does a higher candle power water gas. One per cent. of air mixed with coal gas will take off about 8 per cent. of its candle power, 4 per cent. of air, 25 per cent., and 45 per cent. of air will render the flame practically non-luminous.

With a good quality of water gas, of 25-candle power, the admixture has a fairly constant effect of removing from 2 to 2½ per cent. of the candle power for each 1 per cent. of air present.

The analysis of air for its 3 constituents, which may be determined by ordinary methods and with ordinary apparatus, consists of the absorption of $CO_2$ with KOH, or with barium hydroxide, and of the oxygen by pyrogallate of potassium or with yellow phosphorus, the nitrogen being the difference.

### Acetylene.

| | |
|---|---|
| Formula | $C_2H_2$. |
| Composition by weight | 92.29 per cent. C 7.71 per cent. H. |
| Density or specific gravity, air = 1 | 0.898 |
| Pounds per cubic foot | 0.0687 |
| Cubic feet per pound | 14.56 |
| Cubic feet air necessary to consume 1 cubic foot | 11.91 |
| Gross B.T.U. per cubic foot | 1,474 |
| Solubility, vols. absorbed in 1 vol. water | 1.11 |

Acetylene is an absolutely fixed, definite, chemical combination of carbon and hydrogen. It may be prepared in a state of chemical purity, and in this respect differs from all other artificial illuminants. Acetylene is without physiological action and may be inhaled or swallowed with impunity just as could be hydrogen or nitrogen. Except for possible traces in coal gas, acetylene does not occur in ordinary gases, and in America it is never mixed with other industrial gases. In its commercial form it is rarely free from 2 to 8 per cent. admixture of air, which comes into it from the water in the generator, or is introduced when the generator is charged, or comes from the interstices of the carbide. In chemistry acetylene behaves as an illuminant and may be absorbed with either an ammoniacal solution of cuprous chloride or with bromine; the latter is the better. For the determination of the air contained in acetylene, see paragraphs on oxygen and on air.

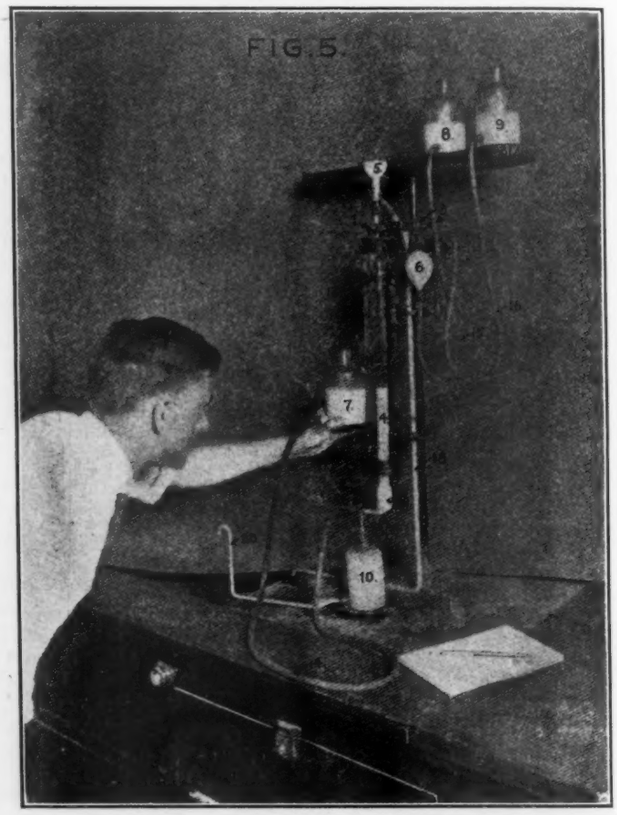
### Method of Gas Analysis.

In order that this paper may serve as a text book for those desiring to undertake this form of investigation, the following instructions, notes, tables, etc., are incorporated. These instructions apply specifically to the type of apparatus in use for the past 6 years in the laboratories of the Peoples Gas Light and Coke Company, of Chicago, and by a number of other gas companies. The tables, deductions, etc., are built upon deductions drawn from results obtained with this apparatus.

The seven constituents which compose most industrial gases, and which are ordinarily analyzed for, are:

| | |
|---|---|
| Carbonic oxide | $CO_2$. |
| Illuminants | Ill. |
| Oxygen | O. |
| Carbon monoxide | CO. |
| Hydrogen | $H_2$. |
| Methane | $CH_4$. |
| Nitrogen | $N_2$. |

Of these, the first 4 are determined by absorption, the next 2 by explosion, the last by difference. The gas analyzing apparatus, shown in Fig. 5, consists of a graduated burette (4), fitted with platinum




electrodes (13), and a storage bulb (6). Three aspirator bottles (7, 8 and 9), with rubber tubing (14, 15, 16 and 17), and an electric sparking outfit, are also required. Both glass pieces are fitted with 3-way cocks (1, 2 and 3). The measuring, explosion, washing and the entire analysis are made in the graduated burette; the bulb (6) is used only for storage of the reserve supply of gas after the CO absorption in case the explosion is unsatisfactory. The burette (4) is usually provided with a water jacket (11), consisting of a large glass tube, confining, by large rubber stoppers at the ends, clear distilled water. A bottle or beaker (10) is placed under cock (2) to form a seal and catch waste reagents and wash water. A removable funnel or cup (5) is attached to burette capillary tube at the top by a ground joint. A secondary funnel (12) beneath (5) serves to drain away excess reagent or wash-water by means of drain tube (18.)

In preparing the apparatus for an analysis, first fill the aspirator and seal bottles (8, 9 and 10) and the leveling bottle (7) with distilled water, previously saturated at the temperature of the water-jacketed burette with the gas to be analyzed, and place aspirator bottles (7, 8 and 9) on shelf (21). By manipulating cock (3) displace all air from rubber tubing (15, 16 and 17), until water entirely free of bubbles flows upward through ground joint into cup (5). Then open cock (2) to seal bottle (10) and purge all air out of tube (14) through cock (2) into seal bottle (10). Similarly, open cock (2) to burette (4) and fill same with water up to funnel. When the apparatus is quite full of water, as described, remove cup (5), open cock on sampling can or pipe from which the sample is to be taken, allow the gas to blow through the hose for a few seconds to insure the expulsion of all air, then attach hose to the ground joint end of the capillary tube at the top of the burette. Turn cock (2) so that the water in burette (4) communicates with the leveling bottle (7), held level with funnel (5). Now open cock (1) so that the gas sample enters burette only, and as the surface of water in the burette (4) is depressed, slowly lower the leveling bottle (7), keeping the surface of water in same slightly above that in the burette, in order to insure no inward leaks of air through loosely attached tubing, etc. When the gas has dis-

placed nearly all water to about a point (19) in the burette, close cock (1), remove rubber tubing at top of burette and replace cup (5). Open cock (3) for a few seconds and expel gas from capillary tubes until water flows into cup (5) and fills it about ¼ full. If the sample is taken from the house piping, or where there is an abundant sample, it is well to allow the gas to flow entirely through the burette and out at the lower stopcock for a few seconds, care, of course, being taken to purge out excess gas from stem of cock (2) into bottle (10) before securing the 100 cc. sample for analysis.

If the gas sample be at a different temperature than the burette, allow it to remain in the burette for a few minutes before proceeding to secure the desired 100 cc. When the gas has assumed the temperature of the burette, raise leveling bottle (7) so that the water level is sufficiently above the 100 cc. graduation of the burette to force small bubbles of the confined sample through the water into cup (5), when the cock (1) is slightly opened. Bubble excess gas sample slowly outward in this manner until, upon closing cock (1) and lowering bottle (7), its water level and that in the burette are at the 100 cc. mark. If the zero mark of the burette be at the cock (1), then the 100 cc. mark is taken for a leveling point, as just described; but if the zero graduation be at the point of capillary retention, where the capillary tube immediately below cock (1) widens into the burette proper, then excess gas is bubbled outward, until the water levels in bottle (7) and burette (4) are at a mark equal to 100 cc., minus the previously determined volume (usually 0.3 or 0.4 cc.) of the capillary tube between cock (1) and the zero graduation at the point of capillary retention. In the latter case, after adjusting the burette water level at 99.7 or 99.6, as the case may be, bottle (7) is placed on a level with (10) and the cock (1) is slightly open until the water in cup (5) slowly enters the burette capillary tube at the top to the point of capillary retention, when it will be found, upon raising bottle (7) that the water level corresponds with the one in the burette, which will be at the 100 cc. graduation. When there is just 100 cc. in the burette the analysis may be started.

Turn the cock (2) so as to connect the burette with the bottle (10), raise the funnel (5) until it is just off its ground joint and drain, leaving about ¼ inch of water in the bottom. Lower the funnel to its seat and put into it about 20 cc. of potassium hydrate solution. Be sure that cock (2) is set so that the burette is connected with (10). Now open cock (1) and let the potassium hydrate solution *drain* very slowly into the burette. When it has nearly all gone into the burette close cock (1) and open cock (3) and let water from bottle (8) or (9) through into the funnel (5) for about 10 seconds. Rinse the funnel and fill it with about 50 cc. of distilled water previously saturated with the gas being analyzed. Pass this washwater *slowly* through the burette, and when nearly all has entered burette, close cock (1). Wait 2 minutes for water to drain down the sides of the burette. Then turn cock (2) so that burette is connected with bottle (7), and read the contraction of the gas, at the same time holding the bottle (7) with the surface of the water in the bottle level with the surface of the water to the burette; also note the reading on the burette graduations coinciding with the bottom of the meniscus of the water level in the burette. The amount absorbed, as indicated by the contraction in cc., or difference in cc., between the 100 and the burette reading, equals the per cent. of carbon dioxide.

Turn cock (2) to connect the burette with the bottle (10), and, with a 1 cc. pipette, put about two drops of bromine into the funnel (5), which should contain about 20 cc. of distilled water. Drain this *slowly* into the burette, as in the previous operation, until the entire gas space in the burette is filled with reddish-brown, bromine fumes, then admit the rest of the bromine and most of the water in the funnel. Next pour into the funnel about 30 cc. of potassium hydrate solution and drain part of this solution in slowly until the water ceases to rise and the burette and the surface of the water are quite free from bromine fumes. Wash with about 75 cc. of aerated distilled water. Wait 2 minutes and measure as explained above. The amount absorbed in cc. equals the per cent. of illuminants.

Now place in cup (5) about 20 cc. of pyrogallic acid solution, and add 20 cc. of KOH solution and allow mixing to take place naturally for about 10 seconds, then drain this through, wash out the burette with about 75 cc. of distilled water and measure in the way previously explained, after waiting at least 2 minutes for gas to resume temperature of burette jacket. The resulting contraction in cc. equals the per cent. of oxygen.

Next, place about 40 cc. of copper monochloride solution in the funnel and drain through very slowly until no further contraction is observed. Then, if no reagent remains in cup (5), add 10 cc. of same reagent and pass it through the burette. Pass in about 50 cc. of distilled water and after this 10 cc. KOH solution, drain through and wash out with about 100 cc. of distilled water. The amount absorbed in cc. equals the per cent. of carbon monoxide. This reagent should be added rather slowly and several minutes allowed for its action on the CO.

The carbon monoxide is the last constituent to be determined by absorption. Of the remaining three, two must be determined by an explosion and the third by difference.

Make a careful note of the reading of the burette after the CO absorption, as this figure has to be used in the $H_2$ and $CH_4$ calculation.

Turn cock (2) so as to give connection between bottle (7) and burette, and cock (3) so as to connect (7) through burette (4) and bulb (6) with (8). Place (8) on the table level with (10) and hold (7) so that its water level is opposite the graduation indicating 10 cc. Now open cock (1) carefully and allow gas to pass very slowly through cocks (1) and (3) into the storage bulb (6). When all but exactly 10 cc. has passed into the bulb (6) close cocks (1) and (3) and place bottle (7) on a level with (10). Pass a little water from (9) directly into the cup (5) so as to get all of the gas out of the passages between the bulb (6) and the cup (5). Also open cock (1) slightly and allow water to pass from cup (5) into burette to zero mark. By manipulating (7) have the amount of gas in the burette exactly 10 cc. A small excess may be gotten rid of through cock (1) and the funnel (5). Turn cock (2) so as to connect burette (4) and bottle (10); remove funnel (5) and connect oxygen hose to top capillary tube. Then open cock (1) and let about 20 cc. of oxygen enter. Remove oxygen tubing and allow about 10 cc. of air to enter burette, exact proportions of oxygen and of air admitted to burette are not essential. Close cock (1), allow water to pass from (9) through (3) and (1) into cup (5), and with bottle (7) lowered, open cock (1) until water passes into burette to zero mark. Then read contents of the burette accurately. The quantity of the mixture in the burette should be in the neighborhood of 40 cc. Attach wires to the electrodes on the sides of the burette, turn cock (2) so that the burette is connected to the bottle (7), see that tubing is straight and cause a spark to pass between the electrodes. After the explosion allow the gases to stand at least 3 minutes before reading the burette. Measure the contraction. This contraction is known as the "First contraction." Make a note of this, then place about 20 cc. of potassium hydrate solution in the funnel (5) and drain the burette. Wash with about 100 cc. of air saturated distilled water and measure. The contraction due to absorption by the KOH solution is known as the "Second contraction." The amount of gas left after the absorption for CO, divided by the amount taken for the explosion, is called the "constant." The amount of hydrogen in the original mixture is equal to the first contraction multiplied by two, minus four times the second contraction divided by three and multiplied by the constant.

(To be Continued.)

## Some of the Perplexities Connected with the Administration of Public Service Utilities.

The authorities of Springfield, O., are having trouble with the local Gas Company, the supply from which is largely (if not altogether) of the natural gas sort. The trouble seems compounded of complaint in about every respect which could be urged—quality, quantity, rate, etc.—and the matter in toto has been dragging in the courts for some time. Indeed, the messing of the matter has been so insistent that, as a last resort, it was proposed to engage the municipality in the supply for public account. Of course, the arguments in the case were many and varied, those of a socialistic turn, in fact, urging that the gas properties be condemned, with a view to acquiring them on a favorable basis (that is, at a ruinous one to the Company), viewed through the socialistic lenses. It is also true that some championed the cause of the Company, and of those who entered the latter's lists, as public communication on the matter, printed in full on the editorial pages of the Springfield *Sun* (Monday fortnight), looks to us, however, much to the point, and in the further remark that its lines generally will appeal to every community in the States that maintains one or more public utilities, we herewith reprint it—the article is from the pen of Mr. Charles S. McKay:

No man who wishes to live an honored, quiet and respectable life will ever have anything to do with a public service corporation. Those who are trying to serve the public in this way were most of them inveigled into the enterprise by designing promoters, and they stay in because they cannot get out.

Just why a man should be regarded as an honorable and desirable citizen when he engages in merchandising or manufacturing, and should be considered a criminal if he undertakes to run a street railway, a gas plant or an electric light service, is one of those anomalies of our modern municipal life that is hard to explain. He is expected to take interest-bearing money from a safe place and put it into an institution which pays no dividends, and to supplement the original investment with numerous other additional installments to keep from losing his first venture.

He invests in rapidly deteriorating material, braves the vicissitudes of municipal politics, endures the abuse of his fellow citizens, and finally sells out his stock at 50 cents on the dollar. All this that the public may be transported from place to place and be warmed and lighted. The wrath of God and the wrath of man are visited upon him, for the winds, the rains, the snow and the ice all combine to rob him of his property. He digs into the earth to find leaks, he paves the surface for the right to pass over it, and he climbs into the air to get out of the way of the populace.

He is expected to serve the public at a loss if necessary, in order to retain his franchise, and public officials spend so much time trying to direct him and to dictate his expenditures, that they seem to have no time left to clean streets, pave highways or do the many other things for which they are paid out of the public treasury. Oh, a public service investment is a cinch—at least many persons think so.

Then, when tax-paying time comes, an assessment is levied on the property, on the gross receipts, the net receipts, the money in bank, and the right to exist and patiently serve the public. When a politician wishes to make a master stroke he announces that he will attack the public service corporations of the city. He kicks up such a row that the companies cannot get the money to make the very improvements the people are howling for.

The owners of public service corporations are expected to call machinery into existence by fiat or mere word of mouth, while it is conceded that other business interests have to wait until it can be made. They are expected to furnish their product from fuel that has to be transported across the country, as cheaply as those who simply draw on the free forces of nature. Obstacles are placed against expansion by imposing prohibitory conditions, and every effort is made to strangle enterprises without which the community could not exist in comfort for a single day.

Worse than all, the credit of these corporations is undermined by continual agitation until they cannot successfully enlist the cooperation of investors, without whose money nothing can be done in these days towards developing a large enterprise. This is the bane of American business life at this time. Legislators exact burdensome ordinances, politicians attack vested interests, and the public cries down its public service companies until home capital draws back and foreign capital will have nothing to do with American securities.

These foreign investors very naturally argue that if we have so little confidence in our own utilities why should they shoulder the risk. If the recent election means anything it means that the business interests of the country are getting tired of such hostile legislation, and if we advance as a people during the next decade, we must assume a different attitude towards our own enterprises. The city that continually obstructs its public service companies will get no improvements—and that for the reasons we have just outlined.

We have no words of palliation for the corporation that plainly does not try to give good service. If a street railway company has not enough cars to properly handle its growing traffic it should get them. The increased business shows that it needs them. The gas company that cannot adequately supply communities on its lines should not be allowed to take on more towns unless it has the product in sight to take care of them. The light company that does not give the service should give up the job, and sell out to the city or lease its plant to a company that will.

In the meantime let the people and their representatives be reasonable, and give local stockholders the same consideration in public service matters that they give to those in other lines of business. Experience has shown that communities that have these enterprises in private hands get the best and most economical service. Only those who use the service have to pay for it. But if municipal ownership is coming, it will not be necessary to build competing plants. Existing ones can be had cheap.

## Address of the President (Mr. E. N. Wrightington, Boston) of the National Commercial Gas Association, Delivered on the Occasion of Its Sixth Annual Meeting, Boston, December 5th to 13th, 1910.

*Growth.*—The report of your Board of Directors will describe the work of your Association during the past year. I would call your attention especially to the remarkable growth of the membership. Two years ago we had about 500 members; last year, at the time of the New York convention, the membership had reached the 1,000 mark; this year, at the time of the opening of the convention, we have over 2,000 members. Great credit is due to the work of the committees on local sections and membership for this increase in membership. We realize that mere numbers are not an evidence of an effective organization. At the same time, a large membership furnishes us with the sinews of war, the funds for carrying on important work, and extends the value of membership over a large field.

*Committee Work.*—Your Directors have met faithfully each month since our last convention, except during the summer time, and have rendered efficient service in the management of the affairs of the Association. The committees appointed to undertake specific subdivisions of the activities for which our Association stands, and especially the chairmen, have also given freely of their time and effort in behalf of the Association.

The Bulletin Committee have succeeded in getting out a monthly paper of which we may well feel proud, but it can be made even better by more hearty co-operation on the part of our members in furnishing material.

The Committee on Local Sections have formed Company Sections in 16 cities.

Of course, the companies represented form only a very small proportion of the total number of gas companies doing business in this country. There is no reason why local sections should not be formed in all of the other companies. I look for a very active campaign to increase the numbers of these sections by our Association during the coming year.

The regular meetings of such men as come in contact with the public are of decided benefit to the company, and the fact that such groups of men are identified with the Association is a decided advantage to them and to the Association.

The Committee on Papers have offered a programme, in which the character of the subjects selected and the caliber of the authors and editors are guarantees of the successful presentation of some very important matters which vitally affect the development of the gas industry.

I would call your particular attention to the make-up of the Public Policy Committee. These members consist of Geo. B. Cortelyou, President Consolidated Gas Co., of New York; Emerson McMillin, of Emerson McMillin & Co., New York; H. L. Doherty, of H. L. Doherty & Co., New York; Randall Morgan, Vice-President United Gas Improvement Co.; Thos. N. McCarter, Public Service Corporation, Newark, N. J.; James L. Richards, President Boston Consolidated Gas Co.

It is a source of great satisfaction that the work of our Association and the objects for which it stands have enlisted the support of such men as these.

The Exhibition Committee have endeavored to prepare an exhibition which will compare favorably with those of previous years. These annual exhibitions are an important adjunct to the work of our Association.

The high standard set by recent exhibitions precludes the possibility of their being conducted without a deficit, unless an undue burden is placed upon the manufacturers. It is only fair that the local gas companies, in return for the value of the publicity resulting from these exhibitions, should contribute toward the expense of conducting them. Local gas companies do not alone profit from this publicity—the manufacturer, who in the ultimate analysis depends upon the public for the sale of his product, is also benefited, and other gas companies throughout the country are helped by the general publicity and the development of the industry which is encouraged by such exhibitions.

The Convention and Entertainment Committee have arranged a list of attractions which we hope will have interest for our members.

*Amalgamation with Other Associations.*—The important part that our Association has taken in the gas industry has brought up again the question of amalgamation with our sister Association—the American Gas Institute. There is a fairly well defined line of demarcation between the interests represented by these two bodies, just as there is between responsibilities of the commercial and the engineering departments of any of the well organized companies which we represent. The American Gas Institute is a body composed of some of the best minds in the gas industry devoted to the technical interests of the business. Our Association is made up of men of boundless enthusiasm and energy applied toward the development of the industry along commercial lines.

Is it wise for these two Associations to be combined? Specialization is the order of the day. Shall each Association go on its separate way, perfecting, as far as possible, its own organization and developing the possibilities in its own chosen field. Such a division of our activities appears to me to be entirely logical, and has already been shown to be productive of exceedingly satisfactory results. In fact, I believe that, so far as our own Association is concerned, what has been done would not have been possible with-

out just this same concentration of effort and responsibility. At the same time, I think we must all agree that our two Associations, acting independently, are like a gas company with an executive for the commercial department, and one for the engineering department, but without a president.

As matters stand to-day, the gas industry has no definite representation. Theoretically, at any rate, there ought to be, to my mind, one big, broad organization taking in the various branches of the business, giving prominence to commercial and engineering matters alike. My personal opinion, however, is that the time is not now ripe for such a step to be taken. For the present I believe that the commercial man absolutely needs the incentive created by the fact that all his effort is directed toward the development of his own organization, and not an organization of which he is only a part.

When the development of each Association has reached the point when it shall seem best to form such an organization as I have outlined, Commercial and Institute men alike must sink their own individuality for the sake of the common cause. Whatever organization may be effected in the future, it is my earnest belief that it will not be effective, nor will it be thoroughly representative of the gas industry, unless it includes the manufacturer of gas appliances. I believe that one of the best things that our Association has done is in getting the gas companies together with the manufacturers through the medium of our annual exhibitions. Although there is still room for improvement, a closer co-operation exists between the gas companies and the manufacturer than ever before.

*Lighting and Industrial Fuel Progress.*—The commercial progress of the gas industry during the past year has been marked by a reawakening of interest in the lighting end of the business, and by the continued developments in the use of gas for industrial fuel.

Whether the fact that some of our companies are interested in the sale of electricity, as well as gas, has been the cause for retarded development of the gas lighting field or not, this branch of the business in the past has been greatly neglected.

Whatever may be said in favor of the development of fuel business to improve the load factor, I believe that many of our companies are making the mistake of concentrating too much attention upon that department of the business. Electric light companies, which are more adversely affected by a low load factor than gas companies, have made large profits from electricity sold for lighting purposes. We have the same opportunity.

We have a medium for producing illumination which is not excelled in quality and economy by any other commercial light source. Although one of these points of superiority, that of economy, is freely admitted by our customers, the failure to take full advantage of the other is probably responsible for any lack of development in our lighting business.

We have been so long accustomed to selling gas for lighting, because it was cheap, that we have failed to emphasize the other advantages. The consequence is that our customers have been ready to make a change to electricity whenever they thought they could afford it, presumably on the theory that because it was more expensive it ought to be better.

Another mistaken idea has been that because gas was cheap it was impossible to sell attractive fixtures for its use. These meetings and exhibitions have done a great deal to improve conditions in this respect, but we are still very much behind the times in our treatment of our lighting fixtures.

I believe that if the gas companies will show a willingness to supply somewhat more expensive fixtures, and those which are attractive, that the manufacturers will willingly get out a better grade. Some manufacturers are already making burners of various sizes, which is a step in the right direction.

*Illuminating Engineering.*—Gas companies should give more attention to the science of illuminating engineering. We make every effort to introduce economies in the manufacture and distribution of gas in order that the price may be reduced a few cents per thousand, while we allow our customers to use inefficient burners and lighting systems which could be replaced with far greater actual saving to the customers than anything we could possibly save them in the retort house and distribution system. Gas is only the raw material, so to speak. Before it become of any value to our customers it has to be transformed into light, heat and power. We may save 5 or even 10 cents per 1000 in the price, but we have the means of saving 25, 50, and even 75 per cent. by proper lighting devices.

It behooves us to give our customers the best, and this means measured in what the customer is interested in, and that is illumination.

*Industrial Fuel.*—I do not propose to encroach upon any of the subject matter of the papers which will come before you during this convention. The subject of industrial fuel will be treated exhaustively, and the recent developments in this line will be shown to you. We, all of us, appreciate the field opened up by this subject. As the price of solid fuel goes up, the price of gas is coming down. Consequently we are continually getting business impossible before. Manufacturers are also being educated to the advantages of gas even at a greater cost.

*Relations with the Public.*—The relations of our public service corporations to the public, it appears to me, have taken a turn for the better. Our companies have come to realize the importance of gaining the goodwill of the public and dealing openly and frankly with them. The public have also been more receptive to education on some of the fundamental principles of their relations with the companies.

*Municipal Ownership a Failure.*—Take, for instance, the fallacy of municipal ownership, which at one time occasioned some agitation. Experience has shown its utter futility. Even eliminating the frequent dishonesty and inevitable extravagance of public ownership, the income derived from charges to the public for service must be practically the same as under private ownership. The municipal plant is subject to the same expenses of manufacture and of distribution as the private plant. Taxes lost by the city are equivalent to taxes paid by the private company. Depreciation, although often ignored by the municipal authorities, goes on just the same as with private ownership.

The rate of return on the necessary investments by the city must also carry more than the ordinary interest rates at which the city bonds are placed, as municipalities are subject to practically the same business risks as are private companies.

But such ideal conditions of operation by municipalities are, in the nature of things, practically impossible of realization. The municipality cannot command the services of the best men as managers of the public undertaking on account of the uncertainties of continuous employment through changes in political control. The demands of political patronage lead to the employment of inexperienced and, oftentimes, unnecessary employees.

Craft and dishonesty are not necessary for the failure of public ownership. Municipalities are notoriously inefficient in conducting their ordinary business, even when administered honestly, consequently we are not surprised to find that in those instances where their activities have been extended to public service undertakings, they have inevitably led to failure.

*Fallacy of Competition Theory.*—Another theory sometimes advanced is that of competition. To the unthinking and inexperienced the principle is plausible enough. Competition in mercantile lines of business leads to reduced prices; why not with public service companies? One reason is because of the duplicate investment required for the competing company. The fixed charges of a public service company are a much greater proportion of the total expenses than is the case with most other lines of business.

Although reductions in price may at first result from the competition, the investments are comparatively so large that sooner or later the two companies must come to some understanding, and one company purchases or consolidates with the other. In the end the public is forced to pay the fixed charges on both investments. This payment takes the form, either of increased price or delay in reducing prices. We need only point to the history of such experiments to prove that such is the almost inevitable result.

*Special Tax for Use of Streets.*—Another fallacy is the exacting of a special tax for the use of the streets. The error in this theory lies in the fact that this tax is really paid for by those who use the service. The best good of the community will result from a service reduced to as low a price as possible, and not burdened with a tax of this character. This is leaving out of the question entirely the possibility of the inefficient use on the part of the city of such funds as may be thus secured.

I venture the assertion that the use of the streets by gas companies occasions far less expense to the city, and annoyance to the citizens in the delivery of domestic and industrial fuel, than the coal teams required to deliver an equivalent amount of solid fuel. If a gas company should pay for the use of the streets, why should not a coal company or an express company or a milk company, which encumbers the public thoroughfares and subjects the people to interference, inconvenience and annoyance, and the streets to expensive wear and tear?

This is the same sort of argument we hear sometimes when gas companies find it necessary in the development of their business to apply for permission to extend their mains to reach some of the outlying districts where gas has never been used before. Some people call the granting of such applications as the giving of a

privilege to the company. If these people had the means of knowing the insistent demands and appeals for the extension from the district which it is intended to supply, they would agree that the advantages to be derived were mutual as between the company and the community.

*Short Term Franchises.*—The theory of the short term franchise is another mistaken belief. Limiting the term of a franchise makes it necessary for additions to be made to the ordinary charges sufficient to cancel the investments at the expiration of the franchise. Such limitation will also lead to the failure to keep the properties in the same first-class order, and will, therefore, result in depreciation in the quality of the service. Improvements and extensions, especially toward the end of the term, will also be postponed, and such equipment as is installed will naturally be of a cheaper quality.

Another error into which the public, especially in some States, are liable to fall, unless the difference is explained to them, is that the rate of return on the par value of the capital invested is not the same thing as the rate of return on the actual value of the property. The return on the value of the property is what should govern rates. The actual capitalization is of small importance to the public.

*Public Regulation and Control.*—Regulation and control of a private company by public authority, if fairly and intelligently exercised, provide a means of adjusting any differences regarding rates and quality of service. There is some danger in such authority assuming administrative functions, and hampering the proper conduct of the business, and where rate making powers are given, of restricting the return on the investment to such narrow limits that capital becomes timid and the development of the business is retarded. The net earnings should not be reduced to the point at which confiscation of property might be claimed by the company, as a fair return on the amount of investment is somewhat more than that which would just escape confiscation. In the long run the most satisfactory results will be secured by a policy which allows considerable freedom to the company as long as an undue burden is not placed upon the public by reason of excessive charges. One disadvantage of this system of regulation is that such extreme power is liable to abuse and much depends upon the personal element. Moreover, when the returns are fixed at a definite amount there is no incentive on the part of the company to introduce economies or improvements in the service.

*The "Sliding Scale."*—Those who do not find in other systems of regulation a satisfactory solution of the problems involved in the relations of public utilities with the public, have been recently attracted to a method long employed in England, but having only one example in this country, namely, in Boston. This method has been applied specifically to gas companies, and is called the "Sliding Scale." The principle of the "Sliding Scale" is as follows:

A standard price of gas is established and a standard rate of dividends. Both the price and the rate of dividends are fixed on such a basis as to secure an adequate return on the money invested in the business. For every reduction in the price the company is allowed to increase correspondingly the rate of dividends which may be paid.

The public is interested primarily in low prices and good service. The amount of dividends paid to the stockholders of the company does not interest the public unless such payments prevent them from getting low prices.

When the payment of extra dividends is not only prohibited unless reductions in the price are made, but increases in the rate of dividend are actually offered as a reward for reduced prices, then the public joins willingly in the partnership.

With the incentive of increased dividends before them as a result of the display of special energy and ability in conducting the business, managers of such undertakings will use every effort to introduce economies, and to increase sales in order that the price may be reduced and the dividends increased. The public will receive the benefit of this increased effort in lower prices. Besides the reductions in price which will result, it is believed that the partnership with the public created by this method develops that mutual good will and confidence which are essential in the relations of all Public Service Corporations with the public.

*Conclusion.*—I desire to thank my associates and all members who have assisted me during the past year. Our Association has a great future formed. It is no stretch of the imagination to look for a membership of 5,000 by the time of our next annual meeting. With the growing interest aroused all over the country in the purposes for which our Association stands, we can go forward with renewed enthusiasm, realizing that our efforts will be an extremely important factor in the development and protection of the industry which we serve.

# Items of Interest
## FROM VARIOUS LOCALITIES.

MESSRS. H. M. BYLLESBY & Co., of Chicago, informs us that the second annual meeting of its managers and department heads and affiliated Companies will be held at the Congress Hotel, Chicago, 17th to 20th prox., included. This steadily growing corporation, the headquarters of which are in the premises 218 La Salle street, Chicago, operates and manages quite a number of gas, electric and street railway properties in the West and South. Since the first convention of its several branches was held some months ago, several properties have been added to its proprietorship, and the former allowance (it numbered 200 at that) will be largely increased. At a recent meeting of a Committee of its managers, preliminary arrangements were made for a session of 4 days, during which a varied programme related to technical and professional subjects will be discussed. It is the belief of President Byllesby that the annual meeting for interchange of ideas amongst the managers and department heads accomplish much towards improving the service afforded the public in the various cities in which its utilities are operated.

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THE following recital (Philadelphia *Telegraph*, 1st inst.) tells succinctly the story of the standing of the ligitation against the United Gas Improvement Company, of Philadelphia, which litigation resulted from causes, the inception of which is well shown in the *Telegraph's* account: "That the United Gas Improvement Company is not responsible for injuries which resulted from the collapse of the building, northeast corner of 11th and Market streets, July 15, 1909, which was at that time being remodeled for the use of the Company, has been decided in an opinion handed down by Judge Buffington, of the United States Circuit Court of Appeals. It will be recalled that four workmen were instantly killed by the collapse of the building, and that several more were so severely injured that they died later. Judge Buffington's opinion came as the result of an action started by Elizabeth Larsen against the United Gas Improvement Company for the death of her husband, Charles H. Larsen, an employee of one of the sub-contractors working on the building, who was caught beneath the wreckage and instantly killed. A jury in the Court below, April, 1910, awarded her $3,000 damages, and a judgment was entered on the verdict from which the Company took an appeal. An effort was made at the trial of the case to show that, notwithstanding the fact the work of altering the building was let out under contract, the Company was in charge of the work, and, therefore, responsible for any accidents that occurred. In the opinion given by the Circuit Court of Appeals, Judge Buffington holds that, although the Company was lessee of the building when it collapsed, it had a contract with a construction company which practically transferred to the contractor possession of the building and gave to the Company no right to dictate as to the means of performing the contract, but only empowered the Company to insist that the building be completed as provided in the plans and specifications. It is also held that the Company took no part in conducting the work and did not interfere with it, and that if there was any negligence such resulted in the death of Larsen, there was no proof to fasten that negligence on the Company. The case was remanded to the Court below with instructions to enter judgment for the Company."

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THE authorities of Clarkston, Wash., have granted to the Pacific Light and Power Company a franchise under which it will be governed for the distribution of gas for light, heat and power uses in the place named. The ordinance provides that the Clarkston authorities will have tke right to regulate the selling price, at stated periods of 10 years, of gas; provided, that at no time will the rate be lower than the rate charged in Lewiston, Wash., from which point it will be carried, or until such time as the quantity sold would warrant the construction of a separate works. The franchise is to run 50 years, from the 1st prox. The active agent in the matter was Mr. William H. Galvani, the Chief Engineer of the Pacific Light and Power Company, whose headquarters are Portland, Ore.

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SINCE the gas plant at Ballston Spa, N. Y., was shut down many complaints have been made by the residents, who, now that they know how to cook with gas are very anxious to have gas to cook with. In fact, the growling has assumed proportions sufficient to cause many to suggest that a gas plant on public account would be about the proper thing.

ADVICES dated San Francisco, the 30th ult., are to the effect that Messrs. H. M. Byllesby & Co., of Chicago, have ordered filed with the County Clerk articles incorporating the Western States Gas and Electric Company, capitalized in the sum of $15,000,000, two-thirds of which is preferred. As a start in the new field the Company has taken over the Stockton (Cal.) Gas and Electric Company and the Richmond Electric Company, of Contra Costa county, Cal.

"DEAR JOURNAL: The Club is an acknowledged organization, so let me tell the story of the binding together, which was made in the new and handsome office building of the Fitchburg (Mass.) Gas and Electric Light Company, the 26th November, when the Fitchburg Gas and Electric Light Club rooms were put into active use, to the accompaniment of banquet, music and games. As you know, in fact as you noted, preliminaries to this organization were taken a month or so ago, when a committee on by-laws and a second to furnish the Club rooms were appointed. So well had these done their work that at the organization meeting the members found their rooms handsomely furnished, the outfit including a piano, billiard and pool tables, lounging, reading and card rooms, bathrooms, kitchen, all furnished for the comfort and pleasure of the clubites. An informal social hour was on the programme for the opening night, which was pleasantly spent in trying out the tables, etc. Following the inspection was the banquet served under the supervision of J. R. Dwyer, and that it was appreciated need hardly be said. The covers sent away—also the platters—the members went into business meeting, and the election for officers thus resulted: President, Clifford R. Hayes; Vice-President, Edward B. Ryan; Secretary, John Gilmartin; Treasurer, G. W. Stiles; Executive Committee, F. O. Clifford, Moses Carman, H. J. Walton, Thos. Flanagan and H. L. Battles. Following the business meeting, came vocal and instrumental entertainment and games of one sort or another until good-bye time arrived. The rooms are to be open at all times, and a series of entertainments will be arranged, mainly on the tournament basis. Visiting gas men, of high or low degree, are invited to pass an evening in the Club house, when either duty or pleasure sends them Fitchburg way.—P. T. M."

THE Gas Machinery Company, of Cleveland, O., has been awarded the contract to furnish the new water gas apparatus for the Kirksville (Mo.) Gas, Heat and Electric Company. The contract also calls for an exhauster, tar extractor, governor, pipe fittings and other necessary adjuncts. The Company has constructed the foundation for a holder up to 75,000 cubic feet, and it will further plan a duplicate steam boiler plant.

SOME time ago we noted the resignation of Mr. Ralph S. Gavitt from the Superintendency of the Leominster (Mass.) Gas and Electric Company, which resignation became effective the 1st inst. Just as he was about to take leave of his former associates and subordinates he was called to the stock room in the basement of the Company's office premises, on the pretext that an accident had taken place. Perhaps the rest of the story is best told by the following description, from the pen of a local correspondent: "He had visions of something unpleasant to mar his leave taking, but was not left to imagining long, for out of the crowd which had there assembled—and they numbered about all those actively connected with the two Companies—Mr. F. V. Johansson stepped out, and, in behalf of himself and the others, presented Mr. Gavitt with a handsome travelling bag furnished with about every accessary to the travelling man. Of course, the recipient was at sea for a moment or two, but not for a lengthy total of time. With a return to equilibrium he responded well to the sentiments of the donors. His successor is Mr. George Spring, who has had charge of the Company's station which serves the sections of Clinton, Harvard and Ayer."

AT a meeting of the Lefferts Park Improvement Company, held in Brooklyn, N. Y., the evening of the 28th ult., the main subject considered was the offer of the Kings County Lighting Company in respect of a revised schedule of gas rates. The original proposition made by the Company was 95 cents per 1,000, beginning January 1, 1911; 1912, 90 cents; 1913, 85 cents; 1914 and 1915, 80 cents. This offer was rejected by the Improvement Company. The other proposition from the Company was this: For the first 10 years, 90 cents per 1,000; for the following 3 years, 80 cents per 1,000. After much consideration the latter proposition, as indorsed by the committee, was accepted by the Association. In this connection the action of the Company certainly favors the public, for it is almost a surety that the Company could, on appeal to the Courts, be sustained in the position of charging at the rate of $1.10, gross, $1, net, for a period of years.

THE Gas Division section, of New Jersey Public Utilities, has assented to the petition of the Public Service Gas Company for the right to issue an additional ½ million of capital stock.

THE property owners of Walkerville, Canada, have voted to sanction the petition of the Windsor Gas Company for the right to distribute gas in the first named place.

WHILE this item will not be much in the way of news to the average meter reader, especially those who "round-up" meters of the prepayment type, it may nevertheless be surprising to some of those who make the gas—the story is from San Francisco: "Some time ago a representative of the Gas Company decided that the gas meter of a certain business house in this city was not working properly; in other words, the Company was of the opinion that it was furnishing more gas than it was getting paid for, so it decided to examine the meter. Imagine its surprise when it found the meter literally full of cockroaches, which had so interfered with the working of the meter that the gas bill jumped up from about $10 a month to something like $25 after the roaches were removed. The business man said that this was the first time he knew that there was any real good in a cockroach."

MR. C. M. KALTWASSER, of New York, has been appointed General Manager of the Lockport (N. Y.) Light, Heat and Power Company, vice Oliver M. Diall, resigned. Mr. Kaltwasser is a graduate (M. E.) of Stevens Institute, Class of 1905, and almost from the attaining of his parchment has been in the service of the Connecticut Electric Railway and Gas Company, with headquarters in Norwalk, Conn. He is a non-emotional sort of chap, and the Lockport folks made no mistake when they invited him to assume charge of their forces.

MR. R. B. HARTER, writing under date of the 5th inst., incloses the following mention from the Cincinnati *Enquirer*: "Public Service Sendmaker recently received from the Union Gas and Electric Company a communication indicating that the Company would refuse to accord the city in the matter of gas consumed for street lighting the sliding scale of prices allowed to large private consumers. The Company contends that each lamp post constitutes a separate unit as a basis for charge, and that it cannot consider the consumption in the aggregate. It further contends that the price of gas to the city for street lighting is definitely fixed in two ordinances and an agreement, a copy of which was inclosed. The letter further points out that, even if it were possible to give the city the benefit of the sliding scale for street lighting, the city would be at a disadvantage, for the grant carries with it a proviso that in the event of a short supply those getting the benefit of the sliding scale will be cut off from a supply. This is done, the letter states, in order that the city may get the preference in the matter of a supply for its street lights. The Company urges its sincerity in the matter by pointing out that in city institutions which use large quantities of gas, such as the Water Works pumping stations and the hospital, discounts in accordance with a special sliding scale, even more advantageous than that to private consumere, are allowed."

"B. M. L.," writing from Oklahoma City, Okla., under date of the 1st inst., says: "On the 6th inst. a new ordinance requiring the Oklahoma Gas and Electric Company to accept a bond instead of cash deposit for the use of meters becomes effective. Unless the Company discovers some plan for side-tracking the ordinance it will have to face a loss in its deposits of between $40,000 to $50,000, which sum gas users have paid in for the installing of gas meters. In instances in which the Company disapproves a bond, the ordinance provides that, upon application, the Council can be asked to pass upon it. Should the Council disapprove the Company is entitled to demand a cash deposit from the consumer."

FERGUSON, MO., has been clamoring for a gas plant for 5 years or more. Lately the clamor became so insistent that a Company (the Suburban Light and Power Company) has been incorporated to construct a gas works. The projectors agree to accept a 20-year franchise, under which gas will be supplied at 80 cents per 1,000 cubic feet, less 10 per cent. for prompt payment. It is estimated that a plant up to the requirements (water gas type) and a fair distributing system will involve an expenditure of $75,000.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHARLES H. WADELTON,
MANAGER.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
**No. 42 Pine Street, New York.**
**Telephone, 2996 John.**

TERMS:

SUBSCRIPTION—Three Dollars per annum, in advance, Single copies, 10 cents.

The JOURNAL is the official organ of the NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

AGENTS:

*New York*—American News Company, 39 and 41 Chambers street.
*Germany*—Lemcke & Buechner, of New York.
*England*—Aug. Siegle, 30 Lime street, London.

MONDAY, DECEMBER 12, 1910.

## The Market for Gas Securities.

The quiet way in which Consolidated has been absorbed during the recent decline naturally resulted in a hardening of prices for it, the gain for the week, being to all intent 3 points in the bid. The opening to day (Friday) was made at 133½ to 133½, and the buyers seemingly well outnumbered the sellers. The business of the Company keeps increasing in wonderful way.

Brooklyn Union is seemingly lifeless, as far as actual transactions in its shares are concerned. Not so, however, in respect of its business, the growth of which is such that next spring it will likely be in the market for more apparatus. Massachusetts gas is 88⅝ to 88½ for the common; 93½ for the preferred. Lacledes are unchanged, likewise Peoples, of Chicago.

## Gas Stocks.

**Quotations by George W. Close, Broker and Dealer in Gas Stocks.**

115 BROADWAY, NEW YORK CITY.

DECEMBER 12.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

| *N. Y. City Companies.* | *Capital.* | *Par.* | *Bid.* | *Asked* |
|---|---|---|---|---|
| Consolidated Gas Co. | $78,177,000 | 100 | 133¼ | 133⅜ |
| Central Union Gas Co.— | | | | |
| 1st 5's, due 1972, J. & J. | 3,000,000 | 1,000 | 98 | 101 |
| Equitable Gas Light Co.— | | | | |
| Con. 5's, due 1932, M. & S. | 1,000,000 | 1,000 | — | 105 |
| Mutual Gas Co. | 3,500,000 | 100 | 155 | 165 |
| New Amsterdam Gas Co.— | | | | |
| 1st Con. 5's, due 1948, J. & J. | 11,000,000 | 1,000 | 100 | 101½ |
| New York & Richmond Gas Co. (Staten Island) | 1,500,000 | 100 | 35 | 50 |
| 1st Mtg. Gold Bds. 5 p. ct. | 1,000,000 | — | 98½ | 100½ |
| New York and East River— | | | | |
| 1st 5's, due 1944, J. & J. | 3,500,000 | 1,000 | 104 | 107 |
| Con. 5's, due 1945, J. & J. | 1,500,000 | — | 97 | 101 |
| Northern Union— | | | | |
| 1st 5's, due 1927, J. & J. | 1,250,000 | 1,000 | 94 | 100 |
| Standard | 5,000,000 | 100 | — | 75 |
| Preferred | 5,000,000 | 100 | 70 | 100 |
| 1st Mtg. 5's, due 1930, M. & N. | 1,500,000 | 1,000 | 100 | 105 |
| The Brooklyn Union | 15,000,000 | 1,000 | 130¾ | 131 |
| 1st Con. 5's, due 1948, M. & N. | 15,000,000 | — | 106¾ | 107 |
| Yonkers | 299,650 | 500 | 130 | — |
| *Out-of-Town Companies.* | | | | |
| Bay State | 50,000,000 | 50 | 5/8 | ¾ |
| " Income Bonds | 2,000,000 | 1,000 | — | 75 |
| Binghampton Gas Works | 450,000 | 100 | — | 65 |
| " 1st Mtg. 5's | 500,000 | 1,000 | 90 | 96 |
| Boston United Gas Co.— | | | | |
| 1st Series S. F. Trust | 7,000,000 | 1,000 | 82 | 85 |
| 2d " " " | 3,000,000 | 1,000 | 47½ | 50 |
| Buffalo City Gas Co. | 5,500,000 | 100 | 5 | 8 |
| Bonds, 5's | 5,250,000 | 1,000 | 73 | 73½ |
| Capital, Sacramento | 500,000 | 50 | — | 35 |
| Bonds (6's) | 150,000 | 1,000 | — | — |
| Chicago Gas Co. Guaranteed Gold Bonds | 7,000,000 | 1,000 | 104 | 106¼ |
| Cincinnati Gas and Electric Co. | 29,500,000 | 100 | 92 | 98 |
| Columbus (O.) Gas Co., 1st Mortgage Bonds | 1,500,000 | 1,000 | 96 | 98 |
| Columbus (O.) Gas Lt. & Heating Co. | 1,682,750 | 100 | 90½ | 91 |
| Preferred | 3,026,500 | 100 | 75½ | 80 |
| Consumers, Toronto | 2,000,000 | 50 | 200 | 204 |
| Consolidated, Baltimore | 11,000,000 | 100 | 106½ | — |
| Mortgages, 6's | 3,600,000 | | 89 | 100 |
| Chesapeake, 1st 6's | 1,000,000 | — | — | — |
| Equitable, 1st 6's | 910,000 | — | — | — |
| Consolidated, 1st 5's | 1,490,000 | — | — | 112 |
| Consolidated Gas Co. of N. J. | 1,000,000 | 100 | 15 | 17 |
| Con. Mtg. 5's | 880,000 | 1,000 | 92 | 95 |
| Bonds | 75,000 | — | — | 100 |
| Denver Gas and Electric | 3,500,000 | — | 102 | 105 |
| Detroit City Gas Co | 5,000,000 | 50 | — | 50 |
| " Prior Lien 5's | 4,619,000 | 1,000 | 97 | 100½ |
| Detroit Gas Co., 5's | 881,000 | 1,000 | 75 | 80 |
| Equitable Gas & Fuel Co., Chicago, Bonds | 2,000,000 | 1,000 | — | 101 |
| Essex and Hudson Gas Co. | 6,500,000 | — | 39 | 40 |
| Fort Wayne | 2,000,000 | — | — | — |
| " Bonds | 2,000,000 | — | 55 | — |
| Grand Rapids Gas Light Co., 1st Mtg. 5's | 1,225,000 | 1,000 | 104¾ | 105 |
| Hartford | 750,000 | 25 | 190 | 200 |
| Hudson County Gas Co., of New Jersey | 10,500,000 | — | 112 | 113¾ |
| " Bonds, 5's | 10,500,000 | — | 108 | 108¾ |
| Indianapolis | 2,000,000 | — | 60 | 70 |
| " Bonds, 5's | 2,650,000 | — | 104½ | 105 |
| Jackson Gas Co. | 250,000 | 50 | 82 | — |
| " 1st Mtg. 5's | 290,000 | 1,000 | 97 | 100 |
| Kansas City Gas Light Co., of Missouri | 5,000,000 | 100 | — | 36 |
| Bonds, 1st 5's | 3,822,000 | 1,000 | 102 | 104 |
| Laclede Gas Co., St. Louis. | 10,000,000 | 100 | 103 | 103¾ |
| Preferred | 2,500,000 | 100 | 91 | 102 |
| Bonds | 10,000,000 | 1,000 | 102¾ | 103 |
| Lafayette Gas Co., Ind. | 1,000,000 | 100 | — | 60 |
| Bonds | 1,000,000 | 1,000 | 60 | 65 |
| Louisville | 2,570,000 | 50 | 143 | 145 |
| Madison Gas and Electric Co. | | | | |
| " 1st Mtg. 6's | 350,000 | 1,000 | 106 | 106¾ |
| " 6 per cent. scrip, due 1910 | 100,000 | 25 | 60 | 60½ |
| Massachusetts Gas Companies, of Boston | 25,000,000 | 100 | 88¾ | 88⅞ |
| Preferred | 25,000,000 | 100 | 93⅛ | 93¾ |
| Montreal Gas Co., Canada | 2,000,000 | 100 | 218 | 218¾ |
| Nashville Gas Light Co. | 1,000,000 | 100 | 110 | — |
| Newark, N. J., Con. Gas Co. | 6,000,000 | — | 56 | 58 |
| Bonds, 6's | 6,000,000 | — | 137 | 138 |
| New Haven Gas Co. | 2,000,000 | 25 | 200 | — |
| Peoples Gas Lt. & Coke Co., Chicago | 25,000,000 | 100 | 104¼ | 104⅜ |
| 1st Mortgage | 20,100,000 | 1,000 | — | — |
| 2d " | 2,500,000 | 1,000 | 104 | — |
| Rochester Gas & Electric Co. | 2,150,000 | 50 | 88 | — |
| Preferred | 2,150,000 | 50 | 118 | — |
| Consolidated 5's | 2,000,000 | — | 104⅜ | 105⅛ |
| San Francisco Gas Co., Cal. | 15,500,000 | — | — | — |
| St. Joseph Gas Co.— | | | | |
| 1st Mtg. 5's | 751,000 | 1,000 | 100 | 102 |
| St. Paul Gas Light Co. | 1,500,000 | 100 | 45 | 47 |
| 1st Mortgages, 6's | 650,000 | 1,000 | 113 | 116 |
| Extension, 6's | 600,000 | 1,000 | 112¾ | 115 |
| General Mortgage, 5's | 2,465,000 | 1,000 | 90 | 95 |
| Syracuse Gas Co., N. Y. | 1,975,000 | 100 | 50 | 55 |
| Bonds | 2,047,000 | 1,000 | 100 | 104 |
| Washington (D. C.) Gas Co. | 1,600,000 | 200 | 367 | 370 |
| 1st Mortgage, 6's | 600,000 | — | — | — |
| Western Gas Co., Milwaukee | 4,000,000 | — | — | — |
| Wilmington (Del.) Gas Co. | 600,000 | 50 | 381 | — |

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NO EXTRA LABOR OR OPERATING EXPENSES.
IMPROVED AMMONIA CONCENTRATOR.
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## Position Wanted.

An experienced gas manager, now employed as manager, desires a similar position either with a natural or artificial gas company, in a city of 20,000 population or over. No preference as to location of city. Can leave present position on 30 days' notice. Results guaranteed.

Address, "A.,"
1843-tf Care this Journal.

## WANTED,

**Position as Manager and Superintendent of Gas Plant.**

Best of references given. Fifteen years' experience in gas business. Address, "F.,"
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## POSITION WANTED.

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## WANTED.

A manager and purchasing agent, of a combined gas and electric plant, desires a similar position in a town of 20,000 or more inhabitants Over 15 years' practical experience and can furnish A-1 references. Would like to give present employers 60 days' notice.

Address, "COSMOPOLITAN,"
1853-1 Care this Journal.

# WANTED,
# A Water Gas Maker.

## New Britain Gas Light Co.,

NEW BRITAIN, CONN.

1853-3

## WANTED,

**Assistant Chief Draughtsman and Checker in Gas Works Design.**

Apply, stating reference and salary expected,
1852-2 CRUSE KEMPER CO., Ambler, Pa.

## WANTED,

**Foreman of Gas Shop in City of 25,000 Population.**

Must be a man of good habits, good manager of men, good pipe fitter, good meter repairer. State experience. Give references. Address, "W. G. & C. C.,"
1852-tf Care this Journal.

## WANTED,

**MANAGER FOR SMALL GAS PROPERTY IN SOUTHERN NEW JERSEY.**

PUBLIC UTILITIES COMPANY,
1853-1 606 Franklin Bank Bldg, Philadelphia, Pa.

## WANTED,

**Traveling Representative by Gas Bench Manufacturer.**

Man with wide acquaintance with gas companies or practical experience in gas bench design and operation, or both
1853-tf Address, "M. S.," care this Journal.

## WANTED,

**A 4½ or 5-Foot U. G. I. Water Gas Set, with or without Condenser.**

Please state condition and best price f. o. b. cars. Address, "LAND,"
1853-1 Care this Journal.

## WANTED,

**ONE 6-FOOT WATER GAS SET IN GOOD SHAPE.**

Address, PORTSMOUTH GAS CO.,
1853-1 PORTSMOUTH, VA.

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**Blowers.**—2 Connersville 68 ft. d.c. to Vertical Engines; 2 McKenzie, belt; 2 positive gas Sturtevant No. 10, belt, with 2 horizontal engines; 3 Roots No. 6, 37 ft. d.c. to Vertical Engines.

**Exhausters.**—1 Connersville 58 ft., belt; 2 Connersville 33 ft. d.c. to Vertical Engines; 3 Wilbraham 55 ft., belt; 1 Roots 37.25 ft., direct; 2 McKenzie 25 ft., belt; 3 McKenzie 15 ft., belt; 1 McKenzie d.c. to Vertical Engine.

**Engines.**—1 Phœnix 11 in. by 14 in. Horizontal; two 6 in. by 6 in. Vertical; 1 Sturtevant, 4 in. by 6 in. Vertical, no wheels. (See Blowers and Exhausters.)

**Flywheels.**—2 C. I., 8 ft. 6 in. diameter, 26 in. face, 10-in. bore.

**Station Meters.**—One 9 ft. 6 in. by 9 ft. 6 in., no drum; one 9 ft. by 9 ft.; one 8 ft. 3½ in. by 8 ft.; one 8 ft. by 8 ft.

**Purifiers.**—4 boxes, 20 ft. by 24 ft. by 3 ft. 6 in.., with 3 covers.

**Condensers.**—Two Multi-tubular, 7 ft. diameter by 23 ft. 4 in.: 401 2½-in. tubes.

**Governors.**—One 20-in. Automatic; one 20-in. Balanced.

**Tanks.**—Of various capacities and shapes.

**Flanged Fittings**—Miscellaneous 16 in., 20 in. and 24 in.

For further particulars apply to
THE BROOKLYN UNION GAS COMPANY,
Kent avenue and Cross street, Brooklyn, N. Y.
1848-3m

## FOR SALE,

**500 Straight Way Meter Cocks, Flat Head, without Check, for Lead and Iron Connections.**

These are brand new, have never been used. Since placing our order for these we have changed our system to straight iron connections. Will allow a liberal discount for immediate sale.
1853-1 Address, "E.," care this Journal.

## FOR SALE.

Tenders will be received for the following second-hand benchwork, up to December 31st.

Arches, 7 feet 6 inches; retorts, 14 inches by 26 inches—McIlhenny lids; need grate and bearing bars. The equipment of about 20 free-firing benches of 6's; furnaces, 12 inches to 14 inches and 28 inches deep. Mains, etc., old style. Bridge pipes, with plugs, old style. The iron in these is in good condition. For particulars, address,

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—AND—

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**Will negotiate either in buying or selling anything needed by Gas Companies.**

**For commercial standing refers by permission to this Journal.**

## BOOKS FOR GAS MEN.

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THE GAS ENGINE, by Forrest R. Jones. 447 pages and 142 cuts. Price, $4.

HEATING, by W. J. Baldwin. Price, $2.50.

PUBLIC LIGHTING BY GAS and ELECTRICITY, by W. J. Dibdin. 528 pages. About 150 illustrations. Price, $8.

AUDEL'S GAS ENGINE MANUAL. 469 pages. 156 illustrations. Price, $2.

GAS MANUFACTURE, by W. J. A. Butterfield. Price, $2.50.

HANDBOOK ON GAS ENGINES, by G. E. Lieckfeld, C.E. Translated by George M. Richmond, M.E. Price, $1.

GAS AND GAS WORKS, by Hughes and O'Connor. Price, $2.50.

CHEMISTRY OF GAS MANUFACTURE, by Harold M. Royle, F.C.S. Price, $4.50.

MODERN COKING PRACTICE, by T. H. Byrom and J. E. Christopher. 168 pages. Illustrated. Price, $3.50.

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— AND —

## NEW YORK, N. Y.

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METER RED.

UNIT "C," NASHVILLE FACTORY.

All the buildings were built of second-hand and old red brick, painted with our "Tennessee" O. H. paint and lined with white.

ONE PIGMENT. ▽ ROASTED FERRIC OXIDE.

WE are making a specialty of indestructible paints for holders and outside structures, and for meters also. Seventeen years in the gas business taught me how to get the results that you need, and have got to have. Take a Little Hint--Don't daub doubtful half dollar or dollar and a half paint on a thirty thousand dollar holder, but get a fifty thousand dollar effect, with durability, by using our "guaranteed gallon" of "dollar delivered" red oxide. You cannot forget the price, because on anything over 50 gallons it is "a dollar delivered."

ONE VEHICLE. ▽ REFINED LINSEED OIL.

A. S. B. LITTLE, General Manager.

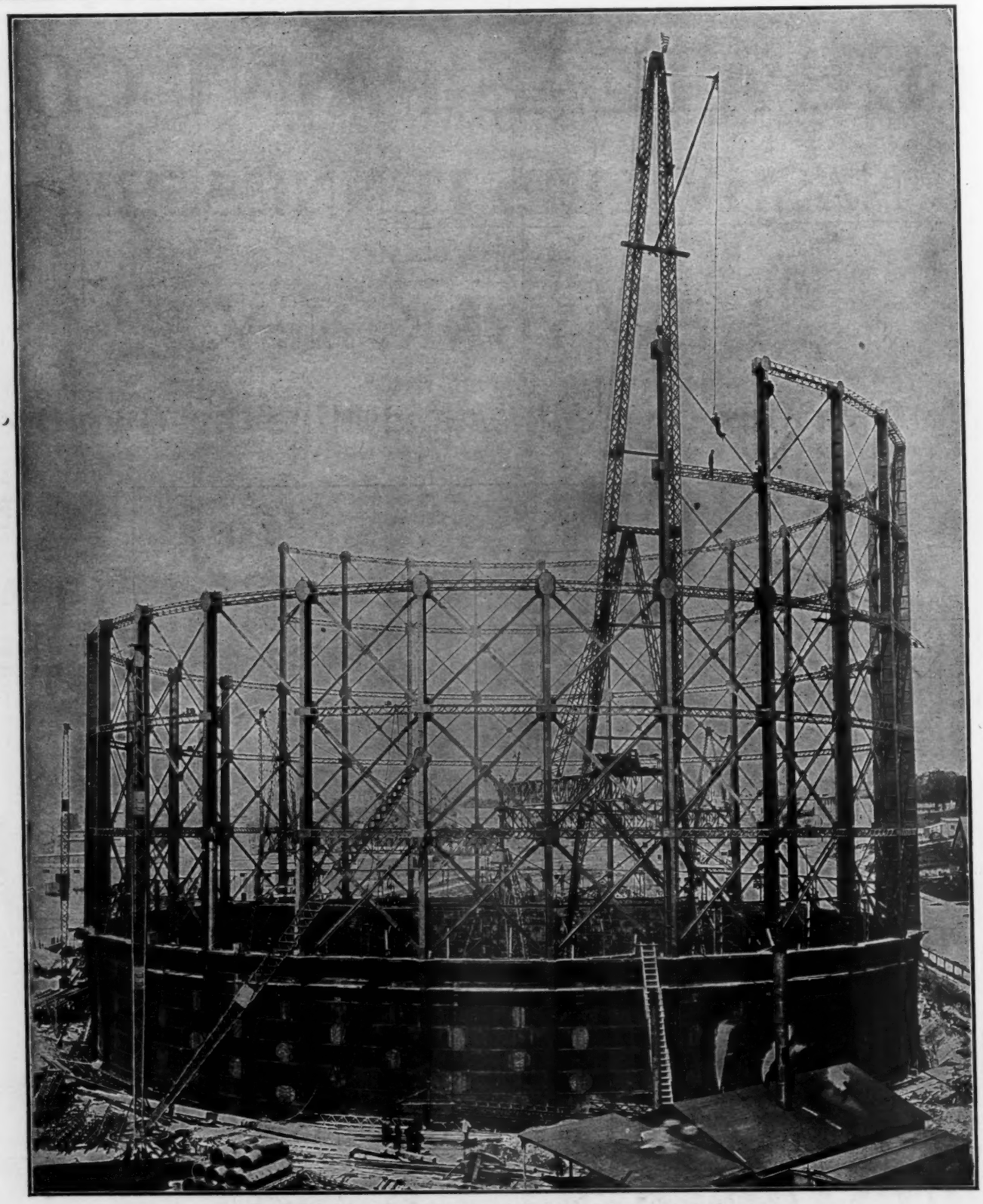

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PLATE AND STRUCTURAL WORK OF EVERY DESCRIPTION.

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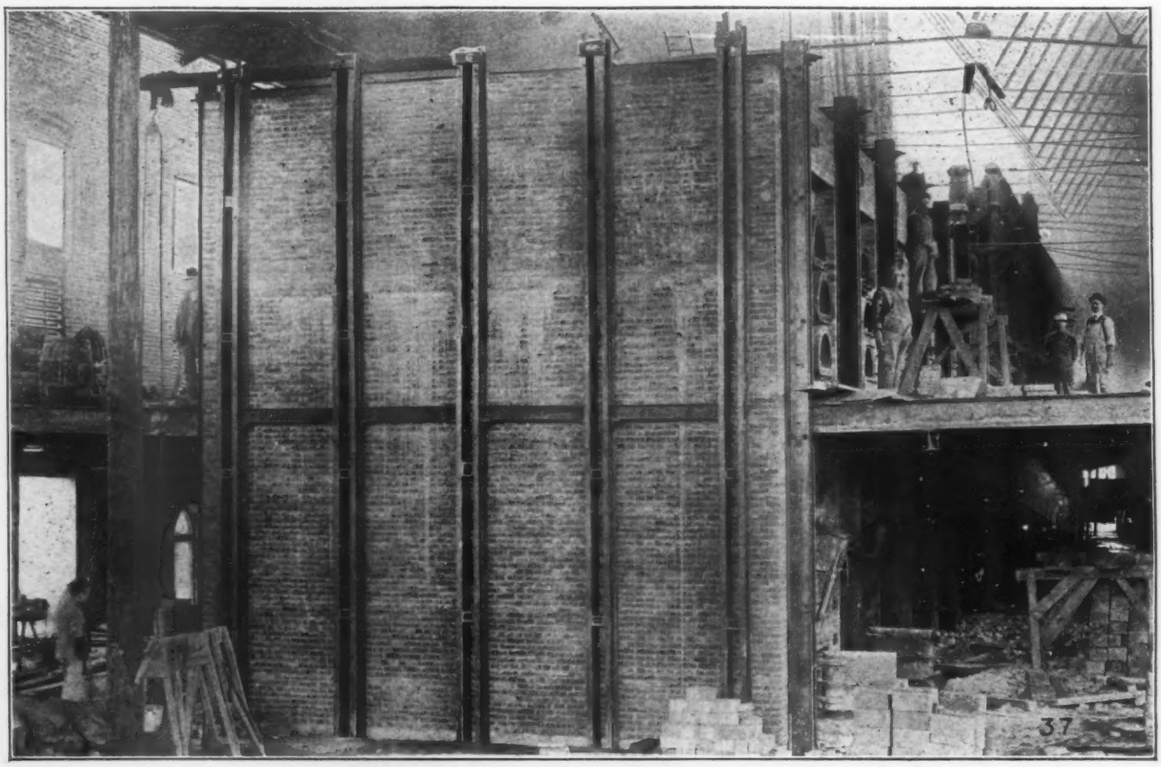

A Part of an Installation of Fifty Doherty Economizer Benches in One Plant.

# A QUESTION OF VALUE.

The true measure of value of a gas bench—as of any mechanical device—is its **earning power,** not the first cost.

You can probably buy cheaper coal than you are now using. But you do not, because you know that either the thermal or the gas value of the coal you are buying makes it well worth the added cost.

You can buy cheaper gas benches than ours. **But when you have an equipment of Doherty Economizer Benches, you have the best possible investment, because they have the highest earning power.**

Consider all that our bench brings to you. It brings a **guaranteed saving** of 20 to 40 per cent. of bench fuel. It eliminates the clinker problem, because **clinker cannot form** in it. It gives **continuous, uninterrupted service.** It makes more gas, because of the uniform heats maintained. It means lower maintenance costs, and longer life.

When you really think about it, aren't these things worth to you many times the slightly higher cost of our bench?

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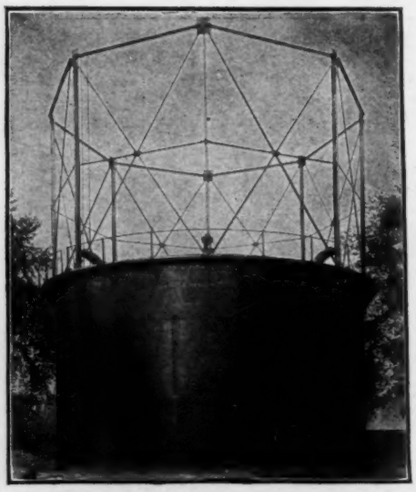
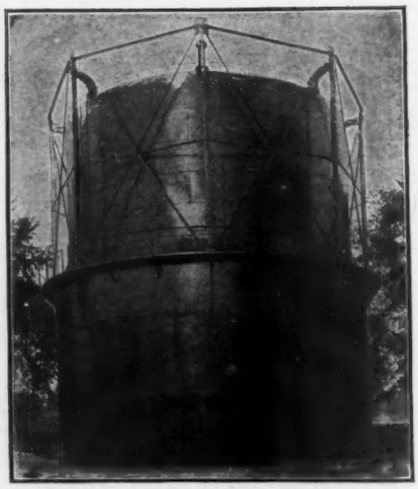
**ENGINEERS DESIGNERS BUILDERS**

**MAIN OFFICE: 60 Wall Street, NEW YORK.**

**Sole Agents for the Dessau System of Vertical Retorts for Michigan, Ohio, Kentucky, Tennessee, Mississippi and All States West of These.**



GAS
HOLDERS,
STANDPIPES,
OIL TANKS, SCRUBBERS,
SMOKE STACKS,
WATER TOWERS.



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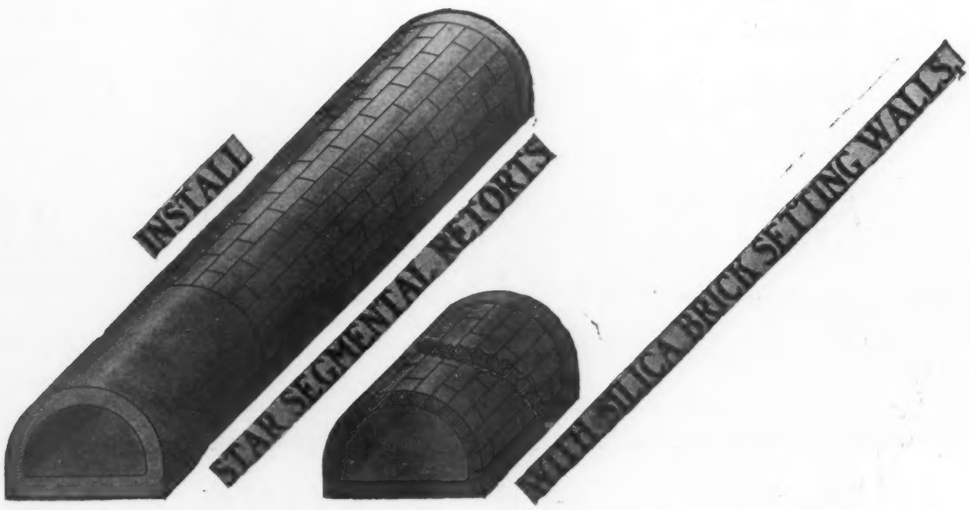
HIGH GRADE RETORTS. BRICK SETTINGS.




**AND GET 150 DAYS' ADDITIONAL LIFETIME**
**On Your Gas Benches.**

IF YOU ARE INTERESTED, WRITE US.

GAS DIVISION.

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*For Gas and Electric Plants.*

## NEW YORK RUBBER COMPANY,

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GAS APPARATUS.

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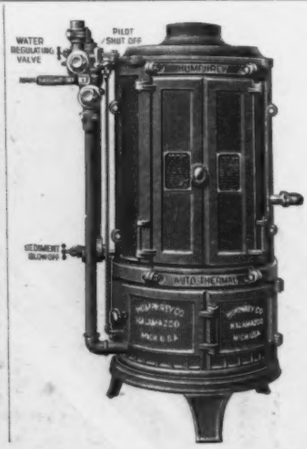


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**HUMPHREY AUTOMATIC GAS WATER HEATERS**

Have the valve at the top; easy and cheap to connect; a sootless bunsen flash pilot; a galvanized, rust-proof, non-clogging burner, and many other things making for trouble freedom and high efficiency. ∴ ∴ ∴ ∴

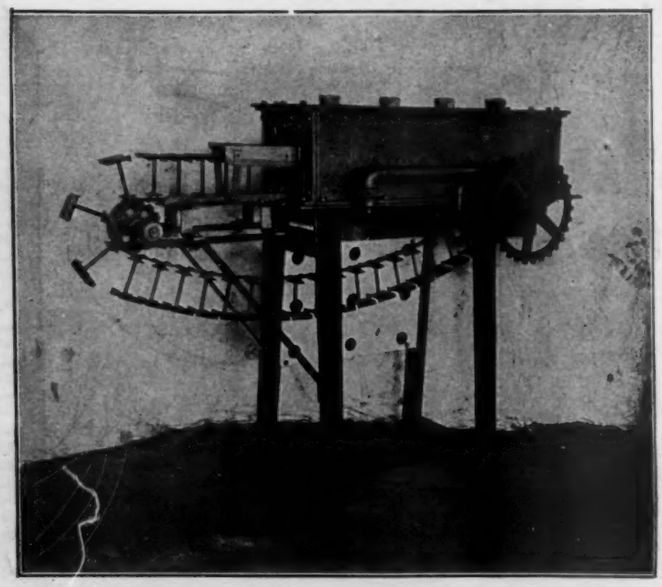
**GUARANTEED.**

They Make Pleased Users.

**HUMPHREY CO.,**
Kalamazoo, Mich.

# GAS FURNACES AND HEATING MACHINES

No. 54 Heating Machine.



This MACHINE recommended for ANNEALING or HARDENING NEEDLES, STEEL PINS and similar work.

"Heating Machines" are Furnaces provided with carriers or propelling machinery for the Continuous Transmission of Work through heated space, for Annealing, Brazing, Hardening and Tempering Quantities.

FOR

**INDUSTRIAL PURPOSES.**

A MOST PROFITABLE DEPARTMENT FOR GAS COMPANIES.

**WHAT WE MANUFACTURE:**

Pressure Blowers, Heating Machines,
Gas Blast Furnaces, Blow Pipes and Burners.

STATE

AMOUNT - } OF WORK
SIZE - - } to be done in
KIND - - } given time.

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You can have an

# All the Year Round

# GAS SHOW

WITH

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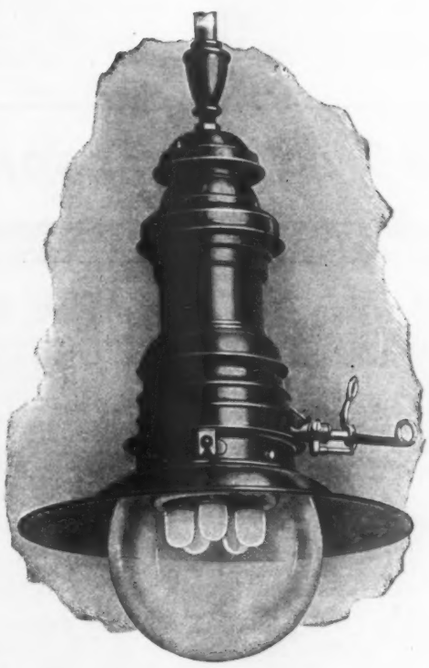

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WE MAKE A SPECIALTY OF

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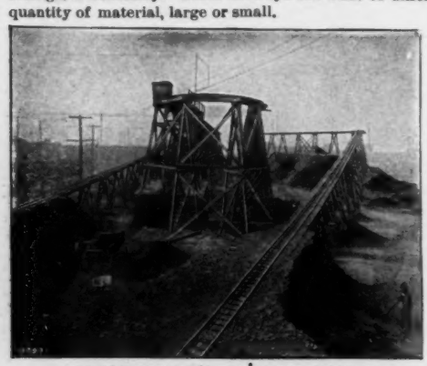
WE HAVE ALL TYPES OF BENCHES IN SUCCESSFUL OPERATION — HORIZONTAL, INCLINED AND VERTICAL SIXES — FULL-DEPTH EIGHTS AND NINES — THROUGH EIGHTS WITH OUTSIDE PRODUCERS.

**SPECIAL DESIGNS TO SUIT LOCAL CONDITIONS.**

## HUNT CABLE RAILWAYS
### FOR HANDLING COAL AND COKE IN GAS WORKS.

**The cost** of handling coal and coke by this method **is only the expense of handling the cars** (one man) **and the power to drive the cable.** Every inch of ground is available, as the space under the trestles can be utilized for storage, if necessary. These railways are built of different types, to handle any quantity of material, large or small.



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If you are interested in the subject we will take pleasure in sending you photographs of some of the plants we have installed upon receipt of your card, and will give such information as in our power if you will let us know requirements.

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## GLOBE STREET LAMPS.

OVER FORTY YEARS IN USE THE WORLD OVER.

THE BEST STREET LAMPS for ALL KINDS OF GAS OR BURNERS.

This is only one of a Large Variety of Styles.

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NO. 100 LAMP.

NOW ON SALE. NEW EDITION IN CLOTH COVERS.

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FOWLER'S PATENT STAND PIPES FOR MACHINE OPERATED RETORT HOUSES.

BUILD YOUR HORIZONTAL 8'S WITH 8-FOOT ARCHES AND REDUCE THE COST OF SETTINGS AND BUILDING.

CONTRACTORS FOR

COMPLETE MECHANICALLY-OPERATED RETORT HOUSES.


## MEETING TIMES OF THE VARIOUS GAS ASSOCIATIONS.

*American Gas Institute.*—Annual meeting, October, 1911. ————. Officers: President, Donald McDonald, Louisville, Ky. Secretary, A. B. Beadle, 29 West 39th st., N. Y. City.

*Canadian Gas Association.*—Annual meeting, June, 1911. ————. Officers President, Arthur Hewitt, Toronto, Ont.; Secretary and Treasurer, John Keillor, Hamilton, Ont.

*Empire State Gas and Electric Association.*—Annual meeting, Nov., 1910. New York City. Officers: President, C. R. Huntley, Buffalo, N. Y.; Secretary, C. H. B. Chapin, 29 W. 39th street. New York City.

*Guild of Gas Managers of New England.*—Annual meeting, December. Young's Hotel, Boston; monthly meeting, second Saturday. Officers: President, A. K. Quinn; Newport, R. I.; Secretary, Walter G. Africa, Manchester, N. H.

*Illinois Gas Association.*—Annual meeting, time, March, Chicago, Ills. Officers: President, A. S. Harrington, Chicago, Ill.; Secretary-Treasurer, C. B. Strohn, Elgin, Ill.

*Illuminating Engineering Society.*—Annual meeting, Oct., —, 1911. Meetings of Sections, monthly. President, E. P. Hyde, Cleveland, O.; Secretary, Preston S. Millar, 29 W. 39th street, N. Y. City. Sections: New York: Secretary, Albert J. Marshall, 36 West 39th street. New England, Secretary, L. D. Gibbs 39 Boylston street, Boston, Mass. Philadelphia, Secretary, F. N. Morton, Broad and Arch streets Chicago, Secretary, F. H. Bernhard, Marquette Building.

*Indiana Gas Association.*—Annual meeting, Jan. 18 and 19, 1911, Fort Wayne, Ind. Officers: President, Carl H. Graf, Indianapolis; Vice-President, S. E. Mulholland; Secretary-Treasurer, Philmer Eves, Indianapolis Gas Company, Indianapolis, Ind.

*Iowa District Gas Association.*—Annual meeting, time, June, 1911, ————. Officers: President, Austin Hurt, Waterloo, Ia.; Secretary and Treasurer, G. I. Vincent, Des Moines, Ia.

*Kansas Gas, Water and Electric Light Association.*—Annual meeting, time, ———— Wichita, Kas. Officers: President, W. A. Scothorn, Hutchinson, Kas.; Secretary and Treasurer, J. D. Nicholson, Newton, Kas.

*Michigan Gas Association*—Annual meeting, time, Sept. 1911; Detroit, Mich. Officers: President, A. P. Ewing, Detroit, Mich.; Secretary-Treasurer, Glenn R. Chamberlain, Grand Rapids, Mich.

*Missouri Electric Light, Gas, Water Works and Street Railway Association.*—Annual meeting, April 13, 14 and 15, 1911; St. Louis, Mo. Officers: President, R. J. Irvine; Secretary and Treasurer, W. J. Cunningham, Springfield, Mo.

*National Commercial Gas Association.*—Annual meeting, December 5-13, 1910. Boston. Officers: President, E. N. Wrightington, Boston; Secretary, Louis Stotz, 29 West 39th street, New York City.

*Natural Gas Association.*—Annual meeting, May 16, 17 and 18, 1911; Pittsburgh, Pa. Officers: President, John M. Garard, Columbus, O. Secretary, T. C. Jones, Delaware, O. Editor Wrinkle Department, F. W. Stone, Ashtabula, O.

*New England Gas Association.*—Annual meeting, third Wednesday in February; Boston. Officers: President, W. H. Snow, Holyoke, Mass.; Secretary-Treasurer, N. W. Gifford, East Boston, Mass.

*Oklahoma Public Utilities Association.*—Annual meeting, May 9, 10 and 11, 1911. Officers: President, E. C. Reynolds; Secretary, Galen Crow, Guthrie, Okla.

*Pacific Coast Gas Association.*—Annual meeting, Sept. 20, 21 and 22, 1911, Oakland, Cal. Officers: President, F. A. Leach, Jr., Oakland, Cal.; Vice-President, W. Baurhyte, Los Angeles, Cal.; Secretary-Treasurer, John A. Britton, 925 Franklin street, San Francisco, Cal.

*Pennsylvania Gas Association.*—Annual meeting, April, 1911, Reading, Pa. Officers President, J. H. Keppelman, Reading, Pa.; Secretary-Treasurer, William H. Merritt, Lebanon, Pa.

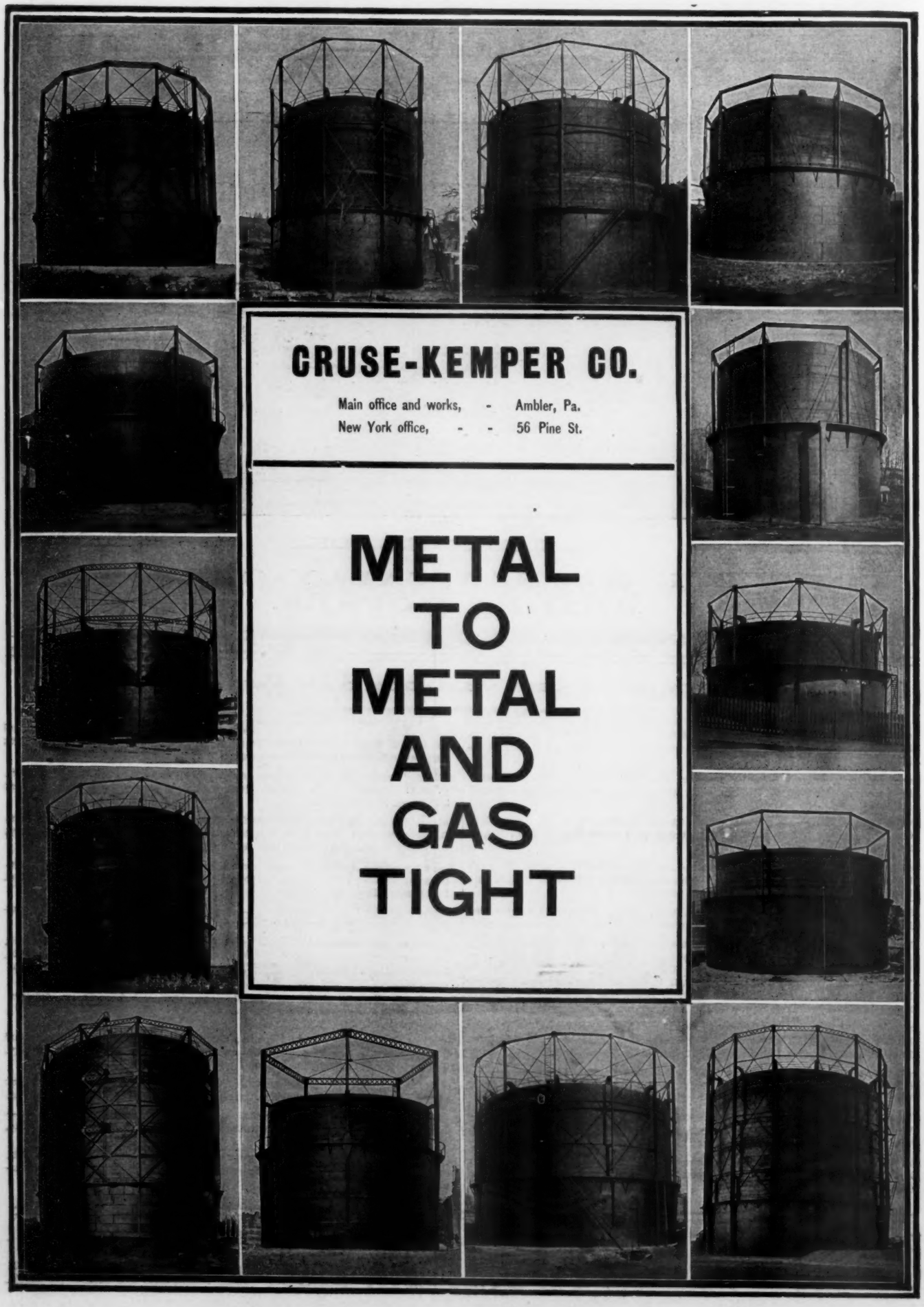
*Society of Gas Lighting.*—Annual meeting, December, 1910; monthly meeting, second Thursday. Place, New York City. Officers: President, Fred. S. Benson; Secretary, George G. Ramsdell, Waterbury, Conn.

*Southern Gas Association.*—Annual meeting, April 19-21, 1911, Montgomery, Ala. Officers: President, H. W. Frund, Salisbury, N. C.; Secretary-Treasurer, Jas. Ferrier, Rome, Ga.

*Southwestern Electrical and Gas Association.*—Annual meeting, May, 1911, ———— Tex. Officers: President, W. B. Tuttle, San Antonio, Tex.; Secretary, H. B. Head, Stephensville, Tex.

*Wisconsin Gas Association.*—Annual meeting, May ————, 1911, Milwaukee, Wis. Officers: President, W. H. Winslow, Superior, Wis.; Secretary-Treasurer, Henry Harmon, Milwaukee, Wis.


Directory of American Gas Companies, 1910. Price, $5.00. For Sale by American Gas Light Journal, 42 Pine St., N. Y. City.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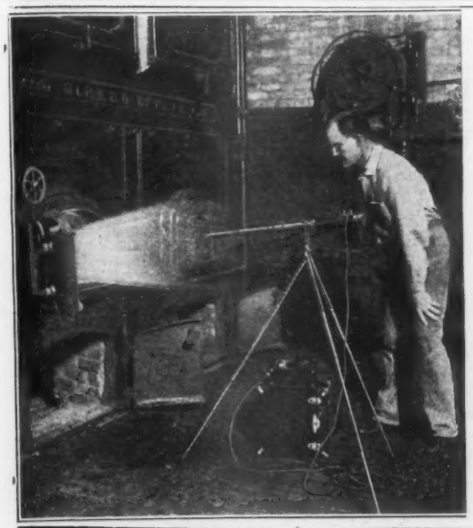
METAL
TO
METAL
AND
GAS
TIGHT



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For all ranges of temperature. Particularly advantageous to Progressive Gas Works. :: :: :: ::

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## GAS EXHAUSTERS AND BLOWERS.

We have a full line of sizes for all standard pressures. The design, material and workmanship is A-1. Prompt Delivery and Reasonable Prices. WHY NOT give us YOUR requirements?

***THE PIQUA BLOWER CO.,***

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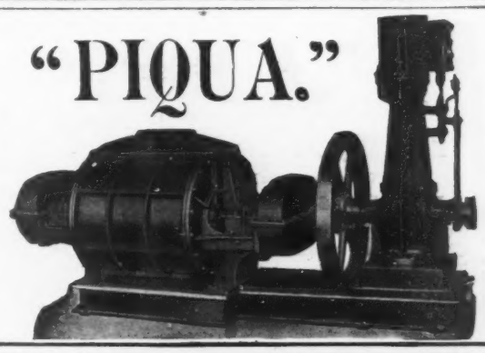

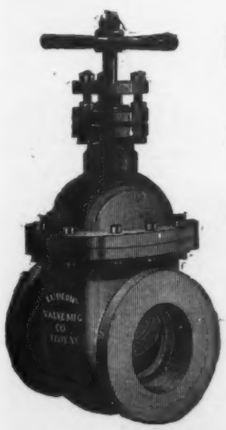

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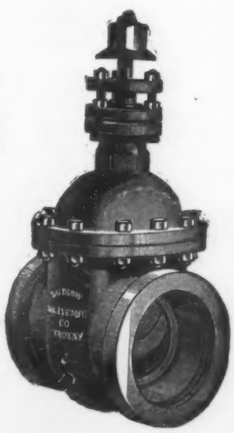

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**Manufacturers of Gas Meters and Water Meters.**

CAST IRON, DRY,

## Gas Meters

While the Ironclad is the most accessible meter, and for this reason the easiest and cheapest to maintain, it is at the same time the most difficult meter to tamper with, owing to the protective seal.

It can be installed easily and quickly and can be placed in any location regardless of whether it be damp or dry.

The case being of cast iron is never scrapped.


## PUBLIC LIGHTING TABLES FOR DECEMBER, 1910.

[COMMUNICATED BY THE AMERICAN METER COMPANY.]

| Day of Week. | Table No. 1. FOLLOWING THE MOON. Date. | Light | Extinguish. | Day of Week. | Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Date. | Complete Lighting in 1 Hour. From Time Given. | Complete Extinguishing in 50 Minutes. From Time Given. |
|---|---|---|---|---|---|---|---|
| | | P.M. | | | | P.M. | A.M. |
| Thu. | 1 | 5.10 N.M. | 6.00 A.M. | Thu. | 1 | 4.07 | 5.52 |
| Fri. | 2 | 5.10 | 6.00 | Fri. | 2 | 4.07 | 5.52 |
| Sat. | 3 | 5.10 | 6.00 | Sat. | 3 | 4.02 | 5.57 |
| Sun. | 4 | 5.00 | 6.10 | Sun. | 4 | 4.02 | 5 57 |
| Mon. | 5 | 5.00 | 6.10 | Mon. | 5 | 4.02 | 5.57 |
| Tue. | 6 | 7.40 | 6.10 | Tue. | 6 | 4.02 | 5.57 |
| Wed. | 7 | 8.50 | 6.10 | Wed. | 7 | 4.02 | 5.57 |
| Thu. | 8 | 9.50 | 6.10 | Thu. | 8 | 4.02 | 5.57 |
| Fri. | 9 | 11.00 F.Q. | 6.10 | Fri. | 9 | 4.02 | 5.57 |
| | | A.M. | | | | | |
| Sat. | 10 | 12.10 | 6.10 | Sat. | 10 | 3.57 | 6.07 |
| Sun. | 11 | 1.20 | 6.10 | Sun. | 11 | 3.57 | 6.07 |
| Mon. | 12 | 2.40 | 6.10 | Mon. | 12 | 3.57 | 6.07 |
| Tue. | 13 | 4.00 | 6.10 | Tue. | 13 | 3.57 | 6.07 |
| Wed. | 14 | No L. | No L. | Wed. | 14 | 3.57 | 6.07 |
| Thu. | 15 | No L. F.M. | No L. | Thu. | 15 | 3.57 | 6.07 |
| Fri. | 16 | No L. | No L. | Fri. | 16 | 3.57 | 6.07 |
| Sat. | 17 | 5.10 P.M. | 6.50 P.M. | Sat. | 17 | 3.57 | 6.17 |
| Sun. | 18 | 5.10 | 8.00 | Sun. | 18 | 3.57 | 6.17 |
| Mon. | 19 | 5.10 | 9.10 | Mon. | 19 | 3.57 | 6.17 |
| Tue. | 20 | 5.10 | 10.30 | Tue. | 20 | 3.57 | 6.17 |
| Wed. | 21 | 5.10 | 11.30 | Wed. | 21 | 3.57 | 6.17 |
| Thu. | 22 | 5.10 L.Q. | 12.40 A.M. | Thu. | 22 | 3 57 | 6.17 |
| Fri. | 23 | 5.10 | 1.40 | Fri. | 23 | 3.57 | 6.17 |
| Sat. | 24 | 5.10 | 2.40 | Sat. | 24 | 4.02 | 6.22 |
| Sun. | 25 | 5.10 | 3.40 | Sun. | 25 | 4.02 | 6.22 |
| Mon. | 26 | 5.10 | 4.40 | Mon. | 26 | 4.07 | 6.22 |
| Tue. | 27 | 5.10 | 5.40 | Tue. | 27 | 4.07 | 6.22 |
| Wed. | 28 | 5.10 | 6.20 | Wed. | 28 | 4.07 | 6.22 |
| Thu. | 29 | 5.10 | 6.20 | Thu. | 29 | 4.07 | 6.22 |
| Fri. | 30 | 5.10 | 6.20 | Fri. | 30 | 4.07 | 6.22 |
| Sat. | 31 | 5.10 N.M. | 6.20 | Sat. | 31 | 4.12 | 6.27 |


# DRAKES
LIMITED,
HALIFAX. ENGLAND.

GAS ENGINEERS AND CONTRACTORS.



# THE NEW MODEL PREPAYMENT METER.

SEND FOR SAMPLE METER AND LET US SHOW YOU THE NEW IMPROVEMENTS.

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Made in 3 and 4 Burners.

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**YOU WHO ARE LOOKING FOR GOOD THINGS NOTE SOME OF THE EXCEPTIONAL FEATURES OF THIS LAMP.**

The Ventilator is made in two vertical hinged sections which may be easily opened, removed if desired, and locked automatically.

The Valve may be removed for cleaning by loosening ONE set screw and turning a hexagon nut. No Springs to get out of order.

All working parts accessible, removable and interchangeable, even while lamp is in operation.

Each Burner has a Separate Gas Adjustment which may be locked after correct incandescence is obtained.

Mantles are suspended in a Plate which raises and lowers on two guide rods—No Jar—No Warping—Great Saving in Maintenance Costs.

Porcelain Burner Noses are held firmly in position by German Silver Cap.

Best Material. Skilled Workmanship. Every Lamp guaranteed mechanically perfect.

**A LABOR SAVER. A LIGHT GIVER. A PRICE SATISFIER.**

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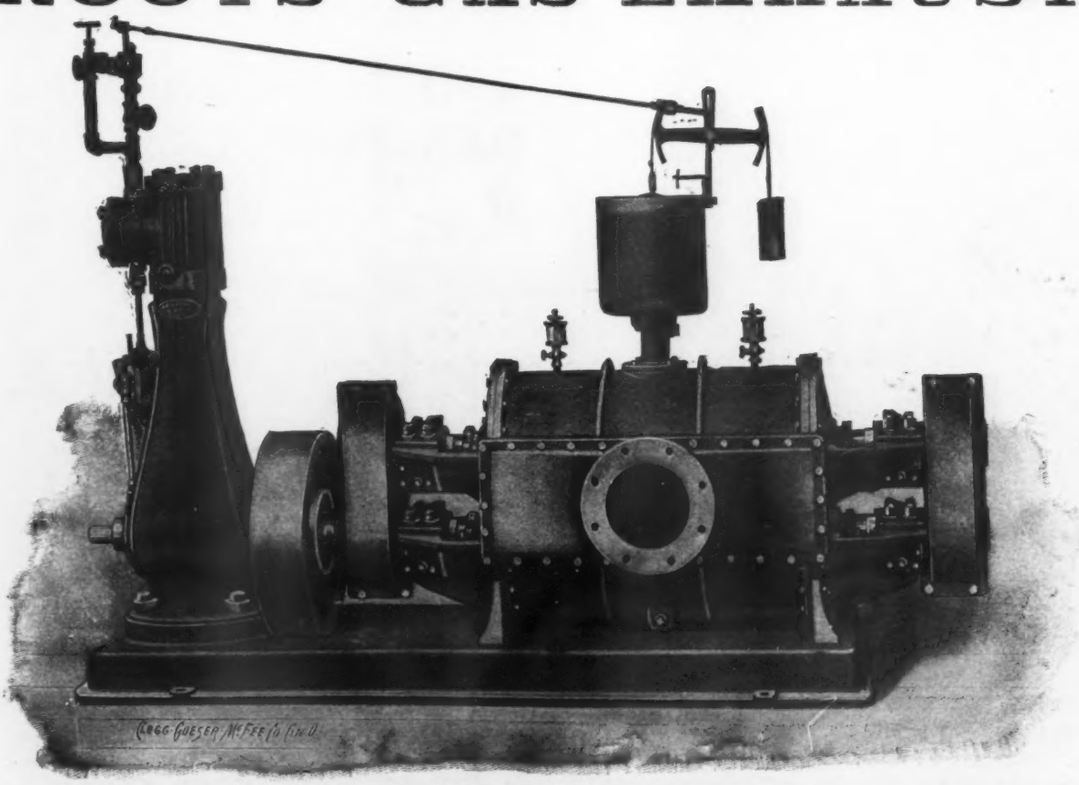
# ROOTS' GAS EXHAUSTERS.



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**Self-oiling, adjustable bronze bearings.**

**Most perfect and sensitive Governor.**

**Write for Catalogue.**

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In that time they have been recommended and used by the leading gas experts, endorsed by the U. S. Government Inspectors of Gas, as well prominent State Inspectors.

To-day the Bray is the only high-grade, absolutely reliable open flame burner on the market.

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**SOLE AGENTS FOR GEO. BRAY & CO., LEEDS, ENGLAND.**

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MANUFACTURERS OF

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FOR WATER AND GAS.

**Also, FLANGE PIPE, LAMP POSTS, Etc.**

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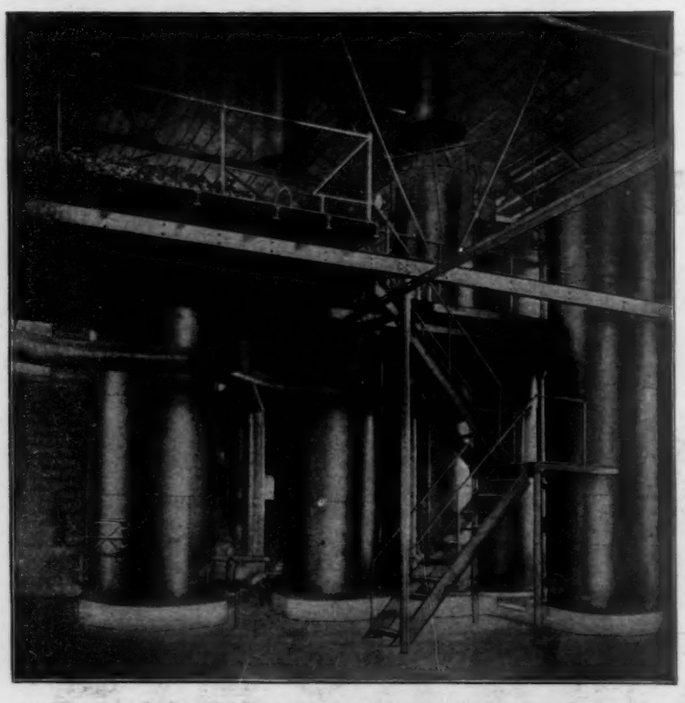

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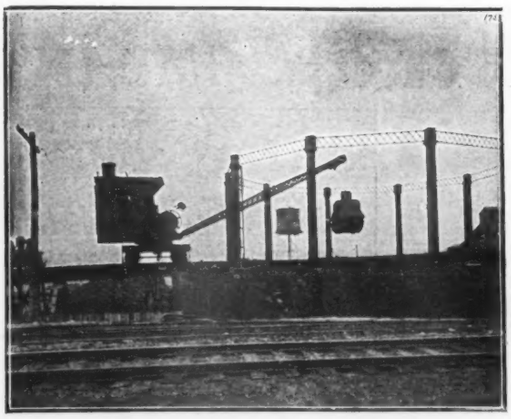

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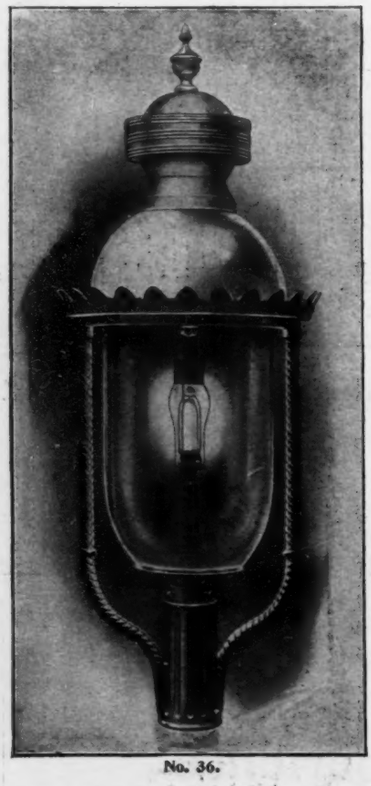

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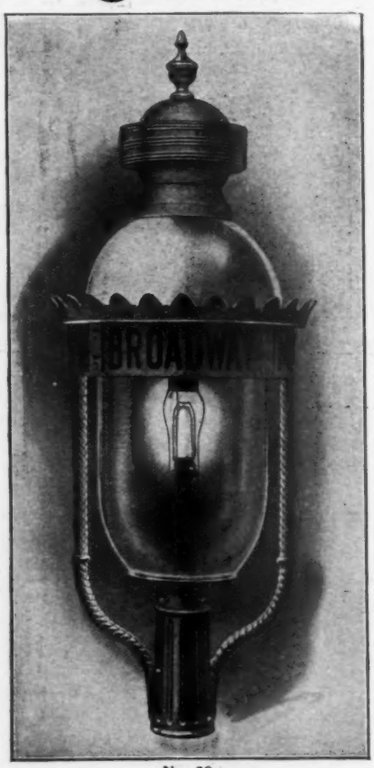

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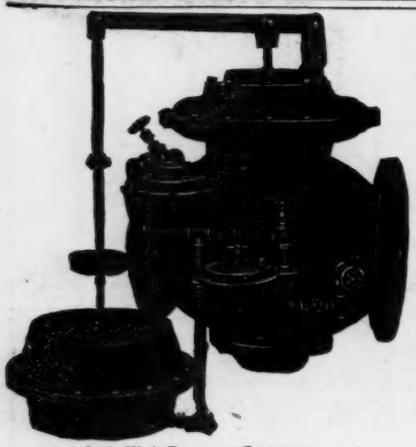

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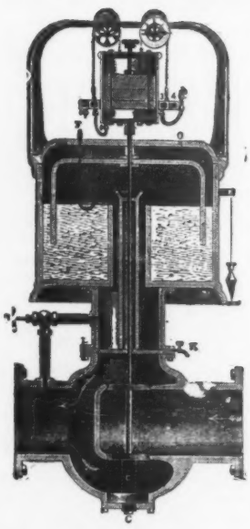

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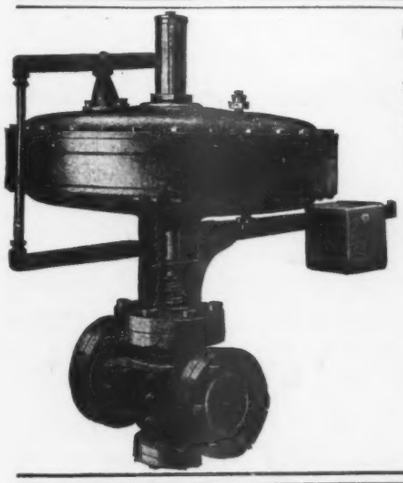

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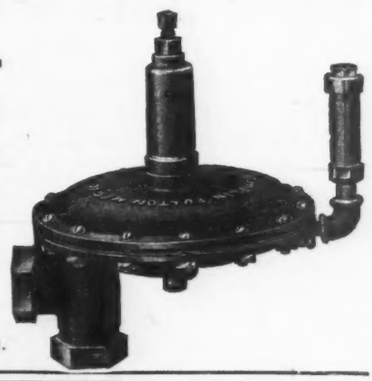

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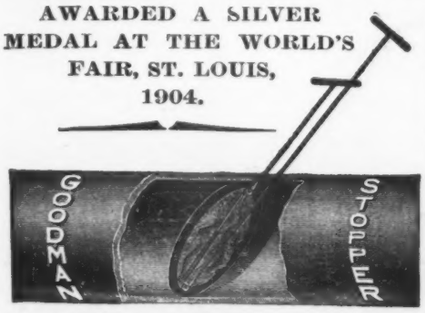


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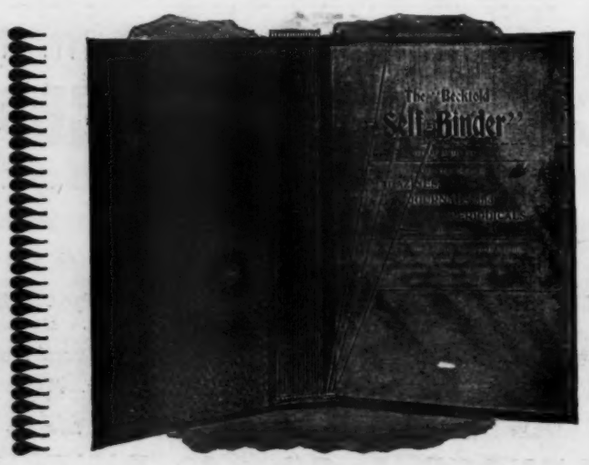


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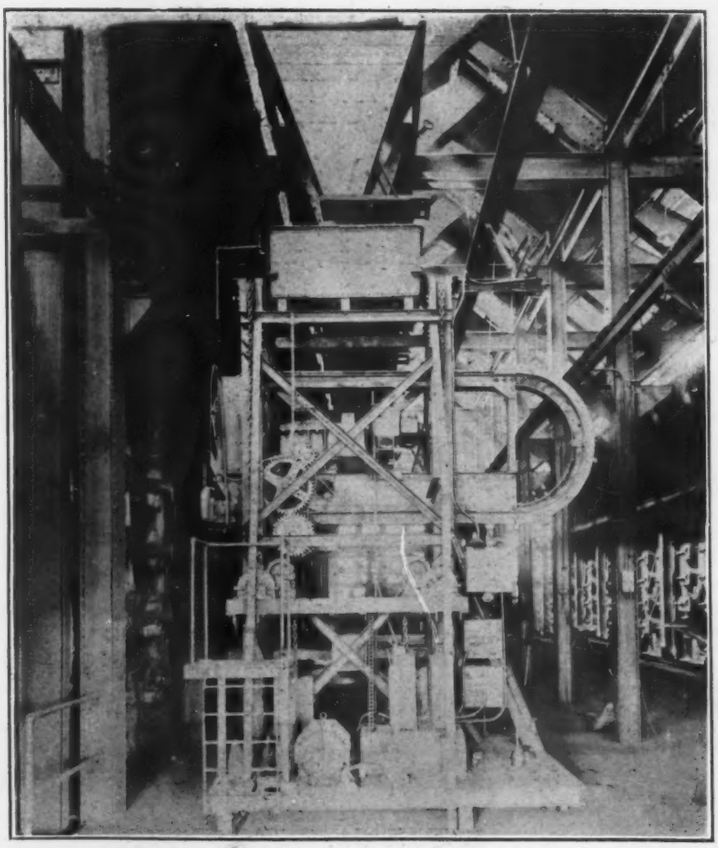

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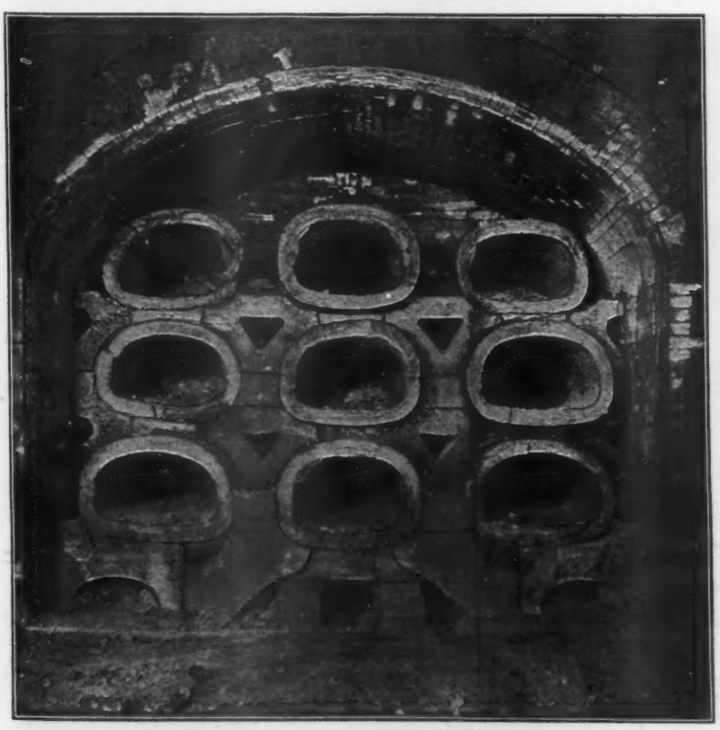

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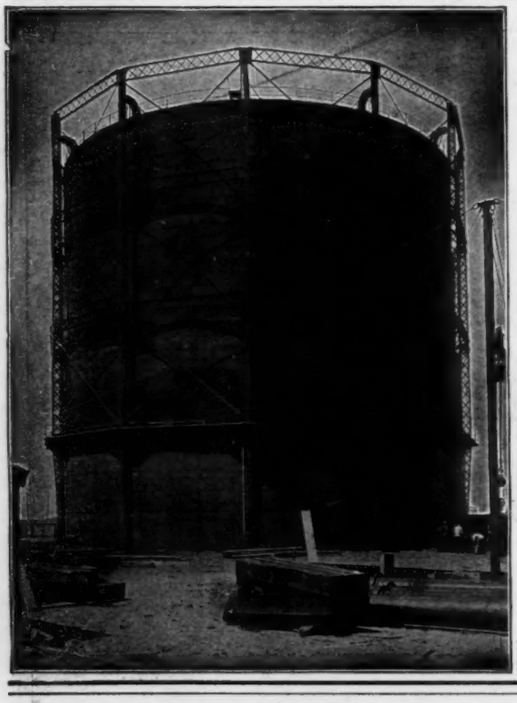

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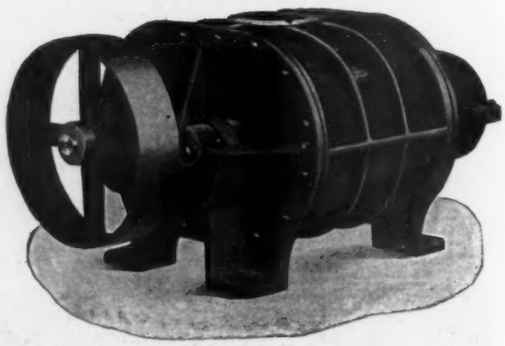

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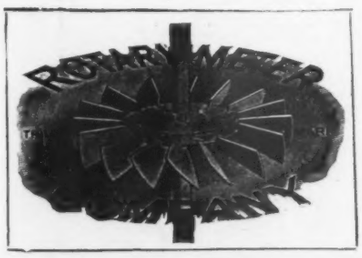


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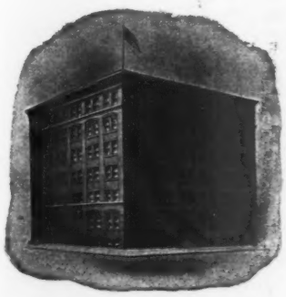

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